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Nearshore Epibenthos of the Campbell River Estuary and Discovery Passage, 1983, in Relation to Juvenile Chinook Diets

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ABSTRACT

Kask, B. A., T. J. Brown, and C. D. McAllister. 1988. Nearshore epibenthos of the Campbell River estuary and Discovery Passage, 1983, in relation to juvenile chinook diets. Can. Tech. Rep. Fish. Aquat. Sci. 1616: 71 p.

In conjunction with surveys of young salmon in and near the Campbell River estuary in 1983, two hundred and forty-two samples of epibenthos, captured by sled, were collected at ten sites. The epibenthos results are described and compared to data from 1982 and with analysis of diets of juvenile chinook salmon.

RÉSUMÉ

Kask, B. A., T. J. Brown, and C. D. McAllister. 1988. Nearshore epibenthos of the Campbell River estuary and Discovery Passage, 1983, in relation to juvenile chinook diets. Can. Tech. Rep. Fish. Aquat. Sci. 1616: 71 p.

De concert avec des relevés de jeunes saumons effectués dans, ou au voisinage de l'estuaire de la rivière Campbell en 1983, on a recueilli à dix endroits deux cent quarante-deux échantillons d'épibenthos, prélevés au moyen d'un traineau. On présente les données relatives l'épibenthos et on les compare à celles de 1982 et aux données d'analyse du régime alimentaire des jeunes saumons quinnats.

INTRODUCTION

There is today a growing awareness of the importance of estuarine and nearshore habitats to the survival of juvenile salmon. However, in many river systems, such as the Campbell River on the east coast of Vancouver Island, the natural estuarine habitat has been degraded by logging and other industrial activities. In 1981, a unique opportunity arose to rehabilitate this estuary and follow the effects on juvenile salmon, especially the chinook.

The Campbell/Quinsam River system drains an area of approximately 1461 km^2 and is characterized by high average annual flows (3816 CFS). The watershed has been extensively altered by man, with a series of dams and lakes which feed into the lower Campbell River. These lakes flush quickly and are classed as largely oligotrophic, contributing little in the way of nutrients and sediments to the estuarine area (Bell et al. 1977).

Five species of Pacific salmon, steelhead and cutthroat trout, and Dolly Varden char all occur naturally in these rivers. These fish all contribute substantially to the commercial and recreational fisheries of this area. A hatchery, built on the Quinsam River in the mid 1970's, produces pink, chinook, coho and steelhead which join the wild populations in their seaward migration each spring. Some juveniles, especially chum and chinook, remain in the estuary to feed and rear for up to several months (Brown et al. 1983, 1984a).

The estuary itself is relatively small, with an intertidal area of approximately 72.5 hectares. Since 1904, log booming activities have occupied a large part of the intertidal area. Much of the natural shoreline has also been altered and removed from production by the construction of marinas, parking lots, seaplane floats, pile bulkheads, barge ramps, sawmills and other industrial facilities.

In 1981 a new dry land sort and log pond was constructed on the east side of the estuary. To replace some of the upper intertidal marsh which was lost, four new intertidal islands were built in the old booming area and planted with marsh grasses. Grooves and bays were also excavated in the islands to provide refuge areas for young fish (Brownlee et al. 1984).

Monitoring of the new and alternate habitats began in March 1982, immediately after the islands were finished. During 1982-83, catches of juvenile salmon were recorded from over 3000 beach seine sets and some fish were retained for analysis. Distribution in the islands was estimated and compared to other sites in the estuary and Discovery Passage. The benthic, epibenthic and zooplankton communities were also sampled to determine the availability of food in each area.

Some preliminary results are reported in Brownlee et al. 1984. Catch data for 1982-83 for all species of juvenile salmon may be found in Brown et al. 1983, 1984a. Stomach analysis of juvenile chinooks in 1982 is presented by Anderson et al. 1984, Brown et al. 1987a, and Kask et al. 1986. The results of the 1982 sled sampling may be found in Kask et al. 1984 and

1986 and Brown et al. 1984c and 1987a. Brown et al. 1984b reports the 1983 zooplankton counts while the 1983 sled counts may be found in Kask et al. 1985.

Here we describe the 1983 sled survey and compare the epibenthos at the established and newly created sites. In addition, we consider the seasonal and zonal differences in density and taxa composition. The contribution of the epibenthic community in the freshwater, estuarine and marine environments to the diet of the juvenile chinook is also discussed.

MATERIALS AND METHODS

Between January and December 1983, nineteen trips were made to the Campbell River area either once or twice monthly. In conjunction with beach seining, epibenthic zooplankton sampling was conducted on eighteen of these trips at ten sites in the study area. Stations were chosen in three zones. The estuarine zone consisted of the tidal area at the mouth of the Campbell River. The transition zone included the area located immediately offshore of the river mouth and subjected to freshwater influence. The remainder of Discovery Passage and Seymour Narrows was defined as the marine zone (Fig. 1 and 2). Within each zone, different areas were sampled to represent the most common nearshore habitats available to the young salmon, suitable for beach seining. In the estuary, sites were chosen to compare the established areas and the new islands. Samples were collected from these stations to assess colonization, densities, taxa composition and production of prey suitable for juvenile salmonids.

Duplicate 0.5 m^2 samples of the epibenthos were collected at each site using a sled with mouth opening 10 cm x 10 cm and fitted with a 100 µ mesh net (Sibert et al. 1977). A 5 m length of shoreline was sampled each time and the samples were preserved in 4% formalin and rose bengal. Samples were collected from low to mid range tidal elevations and on both ebbing and flooding stages, sometimes on the same trip. Often this meant a change in substrate at each site. Surface water temperature and salinity were usually recorded at each site using a Beckman RS-5 salinometer. Tidal elevation at the time of sampling was determined from graphs of the tide heights from the Canadian Tide and Current tables.

In the laboratory, the samples were decanted through a 68 µ sieve and counted on a dissecting microscope fitted with a rotary counter. When required, they were split with a Folsom splitter to include 100 of the dominant organisms. The resultant counts were then multiplied by the split factor to equal the sample total. Organisms were identified as far as possible in the time available and one hundred each of the harpacticoids and calanoids were retained for further analysis. If necessary, the harpacticoids were dissected and the identifications checked against the species description.

The calanoids have not been identified at this time.

RESULTS AND DISCUSSION

A. ESTUARINE ZONE 1983

A-1. Sampling regime

Sampling was designed to compare the established and new island habitats. Four sites, two in the established areas (1, 7) and two in the islands (11, 17) were sampled either once or twice monthly. Two other stations (3, 18) were sampled only in winter - early spring and then were discontinued. Altogether, 140 samples were collected in the estuary (Table 1, Fig. 1).

The four stations sampled regularly in the estuary represented some of the habitat types available to the young chinook. Stations 1 and 7 were in established areas on opposite sides of the estuary. Exposure to freshwater runoff, salt wedge influence and industrial pressures differed at these two sites. In the islands, station 11 represented the typical bay habitat near the head of the estuary. In contrast, station 17 was located on the outer shore of island three closer to the seaward end of the estuary. Chinook were retained for stomach analysis from stations 1 and 7 and six sites on island three, including station 17.

A-2. Physical characteristics

Salinities at the six sites at the time of sampling varied from 0-4.8°/.. and temperatures ranged from 5.0-17.1°C. Tide height changed from 0.5 to 3.1 meters. Eighty-two samples were collected on the ebbing tide and fifty-eight on the flooding tide (Table 1). A complete listing may be found in Kask et al. 1985.

The temperature profiles were similar at each site, lowest in spring and fall and reaching a maximum in July and August. However, the salinity profiles were different between stations and appeared to be only indirectly related to tidal height (Kask et al. 1985). This suggested differing influence by the river flow and salt wedge over the estuary.

A-3. Density and taxa composition of epibenthos in the estuary

The total mean density of epibenthic animals (± 1SE) was 1148 ± 163 m^{-2} (Table 2) for all the samples collected. The epifauna showed three seasonal peaks and reached maximum densities of 5000 ± 2000 m^{-2} in April (Fig. 3).

Of the thirty categories of animals identified in the estuary (Kask et al. 1985), only four were dominant. In the one hundred forty samples analyzed, eggs and copepod nauplii each made up 29% of the total population, followed by nematodes (16%) and harpacticoids (11%) (Table 2). These four categories showed different patterns of abundance, the greatest fluctuations

occurring in the eggs (Fig. 3a-b). The source of the eggs was never ascertained, although their numbers increased in the transition and marine zones and so perhaps they were transported into the estuary with the incoming tide (Table 18).

The mean total densities (±1SE) recorded at the six sites varied from 536 ± 83 m^{-2} at station 11 to 2116 ± 374 m^{-2} at station 17. The greatest abundances at any one site were recorded at station 17 (island three) in mid-April (10666 ± 7586 m^{-2}). The densities at station 11 (island one) were the lowest on approximately one-third of the sampling trips (Table 2).

Eggs dominated the samples at stations 1 (302 ± 195 m^{-2}, 37%), 3 (543 ± 337 m^{-2}, 53%) and 7 (403 ± 197 m^{-2}, 38%) and copepod nauplii at stations 11 (164 ± 42 m^{-2}, 31%), 17 (766 ± 301 m^{-2}, 36%) and 18 (683 ± 323 m^{-2}, 41%) (Table 2). The eggs showed large fluctuations at all sites. The harpacticoids fluctuated the least, especially at stations 1 and 11.

Comparisons of the density of epibenthic animals which were consumed by the juvenile salmon to the CPUA of salmon weighted by station did not show any relationship between the densities of the epibenthos and the numbers of fish caught.

A-4. Density and taxa composition of harpacticoid species in the estuary

The mean total density of harpacticoids (± 1SE) was 123 ± 15 m^{-2}, and during the year there were four peaks in abundance, the highest in July (337 ± 159 m^{-2}) (Table 3, Fig. 3b).

Although forty-five species of harpacticoids were present in the estuary (Kask et al. 1985), Huntemannia jadensis made up 43% of the total population followed by the unidentified copepodites (28%) and the family Ectinosomatidae (13%) (Table 3).

The mean total density of harpacticoids (± 1SE) recorded at the six sites varied from 26 ± 7 m^{-2} at station 3 to 250 ± 123 m^{-2} at station 18 on island four (Table 3).

Huntemannia jadensis was dominant at stations 17 (155 ± 31 m^{-2}, 78%) and 18 (193 ± 99 m^{-2}, 77%). The unidentified copepodites dominated at stations 1 (30 ± 6 m^{-2}, 42%), 3 (14 ± 4 m^{-2}, 55%), 7 (57 ± 17 m^{-2}, 37%) and 11 (30 ± 6 m^{-2}, 45%) (Table 3).

A-5. Comparison of epibenthos and chinook diets at established and island sites

In 1983, two hundred and sixty-nine juvenile wild and hatchery chinook salmon were analyzed for stomach contents from the estuary. Two hundred and thirty-four were from the two established sites (1 and 7) and thirty five were collected from six sites on island three (14, 15, 16, 17,

141, 151) (Fig. 1). There were 146 hatchery chinook from stations 1 and 7, 48 wilds from station 1 and 40 from station 7. There were also 35 wild fish from island three.

Both the wild and marked fish relied on the same food organisms, although in different proportions at the various sites. For all the groups of fish analyzed, freshwater cladocera or marine calanoids were the most important food items (Table 4). Calanoids were dominant at station 7 (wild) and island three (wild), and cladocera at stations 1 (wild and marked) and 7 (marked). Both wild and hatchery juveniles seemed to rely on the freshwater drift from the river and lakes, and on input from the intruding salt wedge. Although some of the larger epibenthic animals were present in the diet (amphipods, harpacticoids, isopods) they usually formed only a small part of the total food intake. Timing in abundance of these animals seemed unrelated to their occurrence in the fishs' diet. The smaller categories which dominated the epibenthic samples in the estuary (eggs, copepod nauplii and nematodes), are not known fish food and were not consumed by the chinook analyzed.

B. COMPARISON OF ESTUARINE ZONE 1982 AND 1983

B-1. Comparison of density and taxa composition of epibenthos in the estuarine zone 1982 and 1983

The time periods sampled in the estuarine zone were quite similar in 1982 (23 Mar - 14 Dec) and 1983 (26 Jan - 7 Dec). There was some change in the stations sampled between the two years.

In 1982, the total mean density of epifauna was 561 ± 92 m^{-2} while in 1983 this increased to 1148 ± 163 m^{-2}. Both years showed approximately three seasonal peaks, but maximum densities reached 5000 m^{-2} in 1983 compared to only 1900 m^{-2} in 1982. The spring peak in numbers also occurred six weeks earlier in 1983 (Fig. 4a).

There was little change in the overall composition of the animals in the epibenthos between the two years. In 1982, eight categories each comprised 1% or more of the total population. In 1983 the same eight, plus cladocerans, also each made up 1% or more of the total numbers present. The rank order of importance showed some variation, the most noticeable being the increase in the eggs in 1983. These were probably transported into the estuary (Table 5).

Thirty samples were collected from station 7 in 1982 and thirty-four in 1983. This site showed similar patterns in both years, but the overall density in 1983 was 1061 ± 221 m^{-2} compared to 425 ± 70 m^{-2} in 1982. This was due largely to an influx of eggs which resulted in densities of over 5000 m^{-2} at this site in April 1983. Some of the other taxa increased as well, but the large numbers of eggs recorded here made up most of the increase in density from 1982 to 1983. This site was dominated by copepod nauplii and nematodes in 1982 and eggs and copepod nauplii in 1983 (Table 5).

In 1982 eight samples were collected from station 17 on island three before a protective boom was installed which restricted access. Thirty-two samples were taken from this site in 1983. This site exhibited a much greater increase in density in 1983 than station 7 (Fig. 4b). A comparison of samples taken over similar time periods showed a marked increase in many categories of epifauna. Overall, densities at station 17 changed from 259 ± 36 m^{-2} to 4392 ± 2095 m^{-2}. This would seem to indicate continued colonization of this site in 1983. Copepod nauplii and nematodes dominated this station in 1982 and copepod nauplii and eggs for a common period in 1983 (Table 5).

B-2. Comparison of density and taxa composition of harpacticoid species in the estuarine zone 1982 and 1983

The mean density of harpacticoids in the estuary was 96 ± 22 m^{-2} in 1982. This increased slightly to 123 ± 15 m^{-2} in 1983 but the overall patterns of abundance were similar.

The same three species were dominant in the estuary in both years although the rank order changed slightly. Huntemannia jadensis showed the greatest change in density, increasing from 1982 to 1983. Of the twelve categories listed in Table 6, half decreased in relative abundance in the population and half increased.

Thirty samples were collected at station 7 in 1982 and thirty-four in 1983. The same three categories were dominant in the two years although there was some change in the relative composition (Table 6). Some of the preferred food species e.g. Tisbe sp. decreased from 1982 to 1983.

B-3. Comparison of epibenthos and chinook diets at established and island sites 1982 and 1983

Although fish from different time periods were included, analysis of the stomachs of wild and marked hatchery juvenile chinook in both 1982 and 1983 suggested that food organisms available from the river drift, intruding salt wedge and littoral estuarine areas were all important in their diets in both years (Table 7). Cladocerans and insects dominated the freshwater group of food organisms. Amphipods, harpacticoids and isopods made up the estuarine group and calanoid copepods the marine group. However, the relative proportions of these food items changed between years and stations, seeming to indicate that these fish were feeding opportunistically.

For all sites combined, the wild juveniles consumed proportionately more freshwater organisms in 1983 than in 1982. The estuarine animals and the marine pelagic group in the diet remained approximately the same in both years. The marked fish showed a shift in all three groups of food. They consumed more freshwater organisms and less estuarine and marine diet items in 1983 than 1982 (Table 7).

Comparison of the diet of the juvenile chinook at station 7 in 1982 and 1983 showed shifts in preferred prey by both the wild and marked fish (Table 7). For the wild juveniles, insects were most important in 1982. In 1983, they relied more on calanoids while freshwater cladocera were equally

important in both years. The marked juveniles consumed mainly calanoids in 1982 but switched to a diet with less calanoids and more freshwater cladocera in 1983.

The diet of the wild fish at island three also changed between years (Table 7). Harpacticoids decreased markedly and calanoids increased as a percentage of the total food intake from 1982 to 1983.

Some of the fish analyzed in 1983 were larger than those in 1982, especially the wild ones at stations 7 and 17 (Table 7). This may be partially reflected in the different diets recorded.

C. TRANSITION ZONE 1983

C-1. Sampling regime

The two sites sampled in the transition zone differed both in physical appearance and habitat type (Fig. 1). Station 20 is located on the east side of Tyee Spit, about 600 m south of the estuary mouth. It is typified by coarse gravel beaches and abundant eelgrass and algae offshore. Flood currents can reach 3 ms^{-1} and ebb currents 2.5 ms^{-1} during spring tides (Bell et al. 1977) and there is often considerable wave action at this site. Station 34 is located north of the estuary, in a low tide channel on the inside of a large gravel bar off the river mouth. The sediments range from fine gravel to sand and an eelgrass bed and Ulva are present in summer.

Forty-six samples were collected at these two sites between February and December 1983 (Table 1). Between March and August, sixty one juvenile chinook were collected for stomach analysis from a nearby site, station 21 (Fig. 2).

C-2. Physical characteristics

Salinities in this zone were usually higher than those recorded in the estuary and ranged from 4.1-32.0°/.. at the time of sampling (Table 1). Salinities at station 34 showed the greatest range and this site seemed to be more influenced by the river than site 20. Maximum temperatures were slightly higher at station 34 and both stations exhibited seasonal temperature curves similar to the estuarine stations (7.0 - 16.0°C) (Kask et al. 1985).

At station 20, samples were collected at a tidal elevation of 0.1-3.4 meters. Access to station 34 was restricted to between 1.0-2.0 meters. Twenty samples were collected on the ebbing tide and twenty-six on the flood stage (Table 1). A detailed listing by sample may be found in Kask et al. 1985.

C-3. Density and taxa composition of epibenthos in the transition zone

The total mean density of epibenthic animals (± 1SE) was 2971 ± 327 m^{-2} for the forty-six samples collected (Table 8). There were approximately three peaks in abundance during the year, maximum densities in July and November reaching over 7000 m^{-2} (Fig. 5).

Although thirty-three categories of epifauna occurred in this zone, eight groups made up 95% of the epibenthos. Copepod nauplii, amphipods, harpacticoids and eggs dominated the population (Table 8, Fig. 5a-b). The greatest fluctuations occurred in the amphipods and they made up most of the November peak in abundance. As in the estuary, eggs were present in the highest numbers in the spring.

The highest mean density was recorded at station 20 in July (7856 ± 304 m^{-2}) and the yearly mean at this site was 1.5 times greater than at station 34 (Table 8, Fig. 6). The patterns of density exhibited by the two stations sampled in this zone were completely different. Station 20 exhibited five peaks in abundance while station 34 showed a large drop in density in the June samples.

Station 20 was dominated by amphipods (890 ± 317 m^{-2}, 27%) and station 34 by copepod nauplii (811 ± 166 m^{-2}, 38%). Harpacticoids were second in importance at both sites (Table 8). Amphipods and calanoids reached much greater densities at station 20. There were also greater numbers of other pelagic categories present (tunicates, euphausiids) indicating less influence by the river flow at this site than at station 34.

C-4. Density and taxa composition of harpacticoid species in the transition zone

The mean total density of harpacticoids (± 1SE) was 574 ± 101 m^{-2}. As in the estuary, there were four peaks in abundance during the year, the highest in July (2688 ± 32 m^{-2}) (Table 9, Fig. 5b).

There were forty-eight categories of harpacticoids present in this zone (Kask et al. 1985). The unidentified copepodites (38%), Zaus sp. (17%) and Tisbe sp. (16%) dominated at both sites combined. Seven categories together made up 92% of the total population (Table 9).

Overall, the yearly mean for harpacticoids was slightly higher at station 20 (630 ± 140 m^{-2}) than at station 34 (446 ± 89 m^{-2}) (Table 9). Maximum densities reached 2688 ± 32 m^{-2} in July at station 20 but only 876 ± 108 m^{-2} in August at station 34.

Both sites were dominated by the unidentified copepodites. Zaus sp. (136 ± 59, 22%), Tisbe sp. (112 ± 32, 18%) and the family Ectinosomatidae (39 ± 10, 6%) were more numerous at station 20 than at station 34.

C-5. Comparison of epibenthos and chinook diets

Between March and August, the stomachs of 10 wild and 51 hatchery chinook were analyzed from station 21 (Table 10), which is located south of station 20 in Discovery Passage (Fig. 2).

As in the estuarine zone, both the wild and marked fish relied on the same food groups but in different proportions (Table 10). The wild juveniles preyed mainly on epibenthic amphipods, while the marked chinook consumed mostly harpacticoids. The epibenthos was important in the feeding of both groups, contributing 65% of the diet of the wild chinook and over 95% of the food intake of the marked chinook in this zone.

The epibenthic data for station 20 suggests that more food organisms, mainly epibenthic amphipods and harpacticoids, were available at this site for the juvenile salmon than at station 34. Beach seine surveys showed juvenile chinook to be present at both sites in 1983 (Brown et al. 1984a) and this zone is undoubtedly important to the juvenile salmon as they migrate seaward from the estuary.

D. COMPARISON OF TRANSITION ZONE 1982 AND 1983

D-1. Comparison of density and taxa composition of epibenthos in the transition zone 1982 and 1983

Only twelve samples were collected from this zone in 1982 compared to forty-six in 1983. The values recorded in 1982 were similar to the combined station averages at the same time of year in 1983. This seemed to indicate no real change in epibenthos densities between the two years. Copepod nauplii were dominant in both years in this zone. In 1982, nematodes, harpacticoids, and calanoids were next in importance while in 1983 it was amphipods, harpacticoids, and eggs.

D-2. Comparison of density and taxa composition of harpacticoid species in the transition zone 1982 and 1983

Comparisons are possible between years at only station 34. Although only six samples were collected here in 1982 and thirty-four in 1983, the same four categories dominated the harpacticoid population in the same rank order in both years. The unidentified copepodites were the most abundant (54% in 1982, 51% in 1983), followed by Harpacticus sp. (25%, 17%), Tisbe sp. (8%, 12%) and the family Ectinosomatidae (6%, 4%). The densities for the zone varied between years, the copepodites (247.7 ± 88.3, 218.7 ± 39.3) and Harpacticus sp. (111.7 ± 65.8) (74.2 ± 19.4) being similar between 1982 and 1983. Other species either increased in numbers from 1982 to 1983 (Zaus sp. 5.5 ± 2.0, 95.2 ± 41.6) (Tisbe sp. 36.2 ± 13.3, 93.9 ± 22.7) or decreased (Heterolaophonte longisetigera 19.8 ± 12.1, 1.9 ± 0.8).

D-3. Comparison of epibenthos and chinook diets in 1982 and 1983

The diets of wild and marked juvenile chinook were analyzed from stations 4, 5, 20 and 34 in 1982 and station 21 in 1983 (Fig. 1, 2). Data was usually available for either 1982 or 1983 at each site (Table 11).

The epibenthos comprised a major part of the food consumed by the wild and marked juvenile chinook in both 1982 and 1983 (Table 11). Epibenthic harpacticoids and amphipods were important in the diet of both groups of fish, although the relative percentages changed in the two years. The wild fish in 1983 relied less on harpacticoids, and more on epibenthic amphipods and pelagic calanoids and decapod larvae. The marked juveniles switched from predominantly calanoids in 1982 to a diet which included mostly harpacticoids in 1983.

E. MARINE ZONE 1983

E-1. Sampling regime

Discovery Passage is a dynamic area, consisting of current swept beaches alternating with protected bays. Two sites were chosen in this zone, station 27 on the outer shore of Gowlland Island across the Passage from the estuary and station 31 in Plumper Bay north from Campbell River through Seymour Narrows (Fig. 2).

These two sites differed in exposure, sediment types and vegetation. At station 27, tidal currents were often swift and the beach consisted of coarse gravel and boulders sloping moderately to a kelp bed offshore. Station 31 was located in a more protected area inside Plumper Bay. Here the sediments changed from fine gravel and sand onshore to mud in the subtidal eelgrass bed. These two sites represent much of the marine zone, excluding the rocky intertidal which makes up approximately 50% of Discovery Passage and Seymour Narrows.

Fifty-six epibenthic samples were collected in this zone between mid-March and early December (Table 1). In addition, fourteen wild chinook were analyzed for stomach contents from a third site, station 25 (Fig. 2).

E-2. Physical characteristics

Salinities in this zone at the time of sampling showed the least variation of any of the three zones (25.6-31.6°/$_{oo}$) and were the most stable at station 27 (Table 1). The temperatures recorded at both sites showed the same pattern as in the other two zones, peaking in summer from a spring low and dropping again in the fall (8.0-13.8°C). However, the changes were slightly less extreme than in the estuary and transition zones. Overall, both stations exhibited similar salinity and temperature curves.

At station 27, samples were collected between 0.6-4.2 meters tidal elevation. The range was slightly less at station 31, 1.0-3.5 meters. Twenty-six samples were collected on the ebbing tide and thirty on the flood stage. Kask et al. 1985 contains a detailed listing by sample.

E-3. Density and taxa composition of epibenthos in the marine zone

The epifauna in this zone showed four seasonal peaks, reaching mean densities of over 60,000 animals m^{-2} in early September (Table 12, Fig. 7a-b). For all the samples collected during the year, the mean density of total epibenthic animals (± 1SE) was 10415 ± 3227 m^{-2}.

Of the thirty-seven categories of epifauna caught in the marine zone (Kask et al. 1985), only six groups made up 97% of the total population (Table 12). The samples were dominated by harpacticoid copepods (5289 ± 2661 m^{-2}, 51%), copepod nauplii (2539 ± 735 m^{-2}, 24%), eggs (1084 ± 289 m^{-2}, 10%) and amphipods (701 ± 293, 7%). Harpacticoids and copepod nauplii were present the most consistently during the year, while eggs were most numerous in the spring and amphipods in the fall (Fig. 7a-b).

While station 27 seemed to show less fluctuations than station 31, the overall mean density at Plumper Bay was over 11 times greater than at Outer Gowlland (Table 12, Fig. 8). The highest abundance of epifauna recorded in this zone was at station 31 in early September when there were almost 120,000 animals m^{-2} present. The great difference between stations 27 and 31 may be a reflection of the different habitat types e.g. bay vs. exposed shoreline.

Eggs were dominant at station 27 (825 ± 276 m^{-2}, 43%) and harpacticoids at station 31 (12162 ± 5993 m^{-2}, 56%). Copepod nauplii were second in abundance at both sites and most categories occurred in the greatest densities at station 31.

There appeared to be no correlation between tide height at the time of sampling and the number of epifauna captured ($r = 0.4798$ $df = 14$).

E-4. Density and taxa composition of harpacticoid species in the marine zone

The harpacticoids made up almost 51% of the epibenthos in this zone and the yearly mean was 5289 ± 2661 m^{-2}. Abundances showed four fluctuations and peaked in early September with over 60,000 animals m^{-2} (Fig. 7a).

There were forty-nine categories of harpacticoids recorded from the two sites (Kask et al. 1985). Tisbe sp. was dominant (52%) followed by the unidentified copepodites (37%). Only five categories combined made up 96% of the total population (Table 13).

Site 31 exhibited substantially higher mean densities (12162 ± 5992 m^{-2}) than station 27 (133 ± 28 m^{-2}). In early September abundances of harpacticoids at Plumper Bay reached almost 120,000 m^{-2}, while the highest density recorded at site 27 was only 411 m^{-2}.

Station 27 was dominated by the unidentified copepodites (67 ± 18 m^{-2}, 51%) and site 31 by Tisbe sp. (6413 ± 3576 m^{-2}, 53%). Most species were more numerous at Plumper Bay.

E-5. Comparison of epibenthos and chinook diets

The diets of 14 wild chinook were analyzed from this zone in 1983, all from station 25 (Fig. 2). This is a gently sloping sand and gravel beach leading out to a kelp bed offshore. Currents here are less than at site 27 but greater than at station 31.

These fish relied to a large extent on harpacticoid copepods, followed by barnacle cypris. They also consumed some decapod larvae (Table 14). Organisms of epibenthic origin contributed over 63% of the food intake of these wild chinook.

There were more of the dominant food organisms available at station 31 in Plumper Bay than at site 27 on Outer Gowlland. Very few chinook, marked or wild, were caught at either of these sites in 1983 (Brown et al. 1984a). However, they were scattered in low numbers throughout the marine zone at other sites, especially in late spring and early summer.

F. COMPARISON OF MARINE ZONE 1982 AND 1983

F-1. Comparison of density and taxa composition of epibenthos in the marine zone 1982 and 1983

This zone was sampled from 23 Mar - 29 Sept. in 1982 and 15 Mar - 7 Dec in 1983. This difference may affect the averages slightly. The mean density of total epifauna in this zone, averaged over all samples, was similar in both 1982 (9876 ± 2691 m^{-2}) and 1983 (10415 ± 3227 m^{-2}). There were four peaks in abundance in both years, but the spring peak was slightly earlier in 1983 and there was also a large spike in numbers in September of this year (Fig. 9a).

There were nine categories of epifauna which each made up 1% or more of the total population in 1982 and only six in 1983. Harpacticoids and copepod nauplii dominated the community in both years. In 1982, amphipods were third in abundance while in 1983 it was eggs. This category showed the most dramatic increase between the two years (Table 15). Many groups (amphipods, calanoids, nematodes) showed almost no difference in density between years.

There are time series of samples available from stations 27 and 31 in both 1982 and 1983. These two stations showed opposite trends in density. There appeared to be a slight drop in the overall mean density at station 27 in 1983. Most categories dropped in abundance from 1982 to 1983 except eggs, which increased over 8 times (Table 15). There was also a slight change in the seasonal pattern, 1982 exhibiting higher densities on over half the sampling times (Fig. 9b). This was especially evident at the end of May and the last week in September when there were large numbers of harpacticoids, and copepod nauplii were so numerous that they had to be estimated at several sites (Table 15) (Kask et al. 1986). In contrast, in 1983 the yearly mean density of animals increased dramatically at station 31, mainly due to a late peak in early September (Fig. 9c). At this site harpacticoids and eggs showed large increases in density while most other categories increased slightly or stayed approximately the same (Table 15).

F-2. Comparison of density and taxa composition of harpacticoid species in the marine zone 1982 and 1983

The mean density of harpacticoids in this zone was slightly higher in 1983 (5289 ± 2661 m^{-2}) than in 1982 (3837 ± 1258 m^{-2}). The patterns of abundance were similar, except for a large peak in early September 1983 which was made up largely of Tisbe sp. and the unidentified copepodites.

This zone was dominated by the same three groups in both years, although the densities increased from 1982 to 1983. Some categories remained almost the same (Harpacticus sp., Diosaccus spinatus, Mesochra pygmaea) while others increased (Microsetella sp., Amonardia perturbata) or decreased markedly (Dactylopodia sp.) (Table 16).

However, at station 27, the overall mean densities decreased substantially from 735 ± 225 m^{-2} in 1982 to 133 ± 28 m^{-2} in 1983. There was a drop in abundance in almost all categories, especially Tisbe sp., the unidentified copepodites and Zaus sp. This may be partially due to the temperatures at this site being warmer in 1982, reaching 15°C in early August. The rank order of importance changed also (Table 16).

In 1983 at station 31, the yearly mean densities increased by almost 2.4 times over those recorded in 1982. The rank order of importance remained the same for the top three categories (Tisbe sp., the unidentified copepodites, family Ectinosomatidae) although the relative percentages changed slightly. Most of the remaining categories either increased (Harpacticus sp., Mesochra pygmaea, Diosaccus spinatus, Amonardia perturbata) or decreased (Dactylopodia sp.) (Table 16).

F-3. Comparison of epibenthos and chinook diets in 1982 and 1983

Fish were usually available for analysis at each site in either 1982 or 1983. During 1982 and 1983, fifty-eight juvenile chinook stomachs were analyzed from this zone, forty-four wild and marked fish in 1982 from stations 23, 24, 25 and 27 and fourteen wild chinook in 1983 from station 25 (Fig. 2).

The wild juveniles analyzed in 1982 were slightly larger than those in 1983 and relied mainly on decapod larvae, calanoids and epibenthic amphipods. In 1983, the wild fish switched to a diet containing predominantly harpacticoids with some cirripede cypris and decapod larvae. There were no marked juveniles examined in 1983, but in 1982 these fish consumed a diet made up largely of calanoids, cumaceans and decapod larvae (Table 17).

G. COMPARISON OF ESTUARINE, TRANSITION AND MARINE ZONES 1983

G-1. Sampling regime in the three zones

The most samples were collected in the estuarine zone (140), followed by the marine (56) and transition zones (46) (Table 1). Overall, slightly more samples were collected on the ebb than the flood tide (128 vs 114). However, T tests performed at each site showed no significant differences between the ebb and flood samples.

G-2. Physical characteristics in the three zones

The range of tidal heights at the time of sampling was the largest in the marine zone (0.6-4.2 m), followed by the transition (0.1-3.4 m) and estuarine (0.5-3.1 m) zones.

The greatest range in salinities was measured at the transition stations (4.1-32.0°/..) followed by the marine (25.6-31.6°/..) and estuarine sites (0-4.8°/..). There was a larger range of temperatures in the estuarine area (5.0-17.1°C) compared to the transition (7.0-16.0°C) and marine (8.0-13.8°C) sites but the seasonal patterns were similar in all three zones (Table 1).

G-3. Density and taxa composition of epibenthos in the three zones

Densities m^{-2} fluctuated and often overlapped in the three zones, the marine zone being the highest (10415 ± 3227 m^{-2}), followed by the transition (2971 ± 327 m^{-2}) and estuarine (1148 ± 163 m^{-2}) zones. Mean densities in the estuarine zone were greater than in the marine zone only in late July. The values recorded in the transition zone fluctuated above and below the estuarine and marine zone densities (Fig. 10). There was little, if any, similarity in timing of peak densities in the three zones.

Densities were also highest in the marine and transition zones in the 1982 samples. This may be the result of higher nutrient levels outside the estuary.

Eggs dominated the estuarine zone, copepod nauplii the transition zone and harpacticoids the marine zone (Table 18). Many categories reached their greatest densities at the marine sites (eggs, copepod nauplii,

harpacticoids). The estuary was characterized by slightly higher numbers of ostracods, worms, cladocerans and mysids. Nematodes were most abundant in the transition zone as were barnacle nauplii and cumaceans.

G-4. Density and taxa composition of harpacticoid species in the three zones

Densities of harpacticoids were greatest in the marine zone (5289 ± 2661 m^{-2}), followed by the transition (574 ± 101 m^{-2}) and estuarine zones (123 ± 15 m^{-2}). The marine zone exhibited four large fluctuations during the year, reaching mean densities of over 50,000 harpacticoids m^{-2} in early September. The populations in the estuary seemed to show the least fluctuations.

There were twenty-three categories of harpacticoids in the estuarine zone and thirty-two in each of the transition and marine zones. The estuary was dominated by Huntemannia jadensis and unidentified copepodites. In the transition zone, unidentified copepodites, Zaus sp., Tisbe sp., and Harpacticus sp. made up the majority of the population. Tisbe sp. and unidentified copepodites were most numerous in the marine zone (Table 19).

G-5. Comparison of epibenthos and chinook diets in all three zones

In the estuary, both the wild and marked chinook relied on marine calanoids most likely transported in with the salt wedge (Brown et al. 1984b) and freshwater cladocera flushed downstream from the lake and river habitats. The epibenthos (amphipods, harpacticoids, isopods, cumaceans) contributed to the diet but usually comprised under 15% of the total diet for either group (Table 4).

Once into the transition zone, the juvenile chinook, consumed mainly epibenthic amphipods and harpacticoids. These two groups alone made up from 64 to 91% of the total diet (Table 10). Calanoids made up a much smaller percent of the diet than in the estuary.

The fourteen wild fish analyzed from the marine zone had eaten mainly harpacticoids (62%), barnacle cypris (24%) and decapod larvae (8%) (Table 14).

Although the proportions of epibenthos in the diet varied from zone to zone, the animals of benthic origin (mainly harpacticoids, amphipods, isopods and cumaceans) formed part of the diet in all three zones. They were most important in the transition zone, followed by the marine and estuarine areas. Densities of the dominant prey items were the highest in the marine and transition zones (Table 18).

H. GENERAL DISCUSSION

A prime goal of the restoration of the Campbell River estuary was to increase the food and habitat available to the juvenile salmon in the system, in particular the wild chinook. Monitoring of the occurrence of both wild and hatchery chinook, in the islands and alternate habitats, began in early 1982. Surveys were designed to determined if the removal of booming activities and addition of the new islands would improve rearing capacity for these young fish and food available to them.

Sampling in 1983 indicated that, for the estuary overall, the density of epibenthos had approximately doubled (Fig. 4a). However, most of this increase was due to the influx of eggs in early 1983 which accounted for 55% of the change in density between the two years. The epibenthos which were important as fish prey (amphipods, harpacticoids) had also increased. However, their densities were still far lower than recorded in the other two zones (Table 18). The results were similar at the established site, station 7. The overall mean density at this site also doubled from 1982 to 1983, but 62% of the increase was due to eggs alone. The greatest changes were evident at station 17, on island three. This station showed increased abundance, especially in nematodes, eggs, harpacticoids and ostracods (Table 5, Fig. 4b). Some of the other fish prey (cladocerans, isopods) also appeared more numerous at this station in 1983, but only limited samples were collected from this site in 1982 for comparison.

Long term studies of epibenthos by other researchers have demonstrated yearly fluctuations in densities to occur as apparently natural phenomena (Coull 1985). Continued sampling will be necessary to determine if construction of the new island habitats has been successful. Although the densities of some of the categories of epifauna changed little from 1982 to 1983, others fluctuated quite substantially. Changes in temperature, salinity, sediments, predation and other factors may all influence the epifaunal community.

It is notable that the densities of animals m^{-2} changed so dramatically between zones in both 1982 and 1983, with the marine zone reaching the highest densities in both years. This may be partly due to differences in nutrient concentrations, currents, and stability of the various locations. In accordance with the change in epibenthos, the prey species taken by the juvenile salmon also changed from zone to zone, indicating an opportunistic feeding pattern.

Monitoring of the residency of juvenile chinook in the estuary showed overall reduced catches from 1982 (CPUA=52) to 1983 (CPUA=16). The catches of both wild and marked chinook in the islands dropped from a mean CPUA of 203 in 1982 to 6 in 1983, making it difficult to assess the role of the island habitats in the chinooks' survival. However, sampling in 1984 and 1985 suggests substantially increased catches in the new islands (Brown et al. 1987 b).

Kask et al. (1986) compared the diet of the juvenile salmon in the estuary and nearshore areas to that of previous studies and found differences in prey items between years and areas. In 1983, the diets of all the chinook analyzed in all three zones had changed from that recorded in 1982. This seemed to again indicate an opportunistic feeding pattern by all groups analyzed.

With the extensive alienation of the upper littoral zone and shoreline, the islands should become important in increasing salmonid food production in the estuary. Further information is necessary on high and low tide differences and colonization of epifauna. The contribution of the salt wedge to the estuarine food chain also needs to be assessed.

As discussed in Kask et al. 1986, the Campbell River estuarine zone appears to have a low average abundance of epibenthos compared to other areas. There was some improvement from 1982 to 1983, especially at island three (station 17) but the overall averages for the same time periods are still below those recorded on the Nanaimo or Fraser River deltas (Sibert et al. 1977, 1982). The extensive alteration of the watershed by numerous dams and the alienation of the estuarine foreshore by industrial developments may be partially responsible for these differences.

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Table 1. Summary of physical characteristics at each site in the three Campbell River zones 1983.

Dates	Zone	Stn. no.	Location	No. samples	Tide		Surface	
					Type (ebb, flood)	Ht (m) range	Sal. (°/..) range	Temp. (°C) range
22 Feb.-6 Dec.	Estuarine	1	Mother Ramp	34	9E, 8F	1.0-3.1	0- 4.3	5.6-15.6
26 Jan.-28 Mar.	Estuarine	3	Nunn's Creek	6	3E	0.5-1.9	0- 4.8	5.8- 6.0
27 Jan.-6 Dec.	Estuarine	7	North Baikie Mouth	34	11E, 6F	0.5-2.8	0- 2.8	5.0-15.6
22 Feb.-7 Dec.	Estuarine	11	Island No. 1	30	8E, 7F	1.2-3.1	0- 4.5	5.7-13.8
22 Feb.-6 Dec.	Estuarine	17	Island No. 3	32	8E, 8F	1.7-2.8	0- 1.8	5.0-17.1
29 Mar.-5 May	Estuarine	18	Island No. 4	4	2E	2.3-2.5	1.1- 1.9	5.9-12.1
22 Feb.-6 Dec.	Transition	20	Boat Ramp	32	7E, 9F	0.1-3.4	18.0-32.0	7.0-13.7
14 Apr.-17 Aug.	Transition	34	Painters Channel	14	3E, 4F	1.0-2.0	4.1-28.6	7.6-16.0
15 Mar.-7 Dec.	Marine	27	Outer Gowlland	32	5E, 11F	0.6-4.2	28.6-31.6	8.0-13.8
13 Apr.-4 Oct.	Marine	31	Plumper Bay	24	8E, 4F	1.0-3.5	25.6-31.6	8.5-13.0

Table 2. Mean density m^{-2} ± 1SE and percent of total population of dominant epibenthos at six stations and all stations combined in the Campbell River estuarine zone 1983.

Station No.	1		3		7		11		17		18		All	
Station location	Mother Ramp		Nunn's Creek		North Baikie Mouth		Island # 1		Island #3		Island #4			
No. samples	34		6		34		30		32		4		140	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Taxa														
Eggs	302.3±195.0	36.6	543.3±337.3	53.1	403.1±197.2	38.0	81.5± 21.5	15.2	521.8±258.3	24.7	180.5± 89.0	10.9	336.5± 90.7	29.3
Copepod nauplii	142.6± 22.9	17.3	166.7± 86.8	16.3	247.1± 58.4	23.3	163.5± 41.8	30.5	765.7±300.8	36.2	683.0±323.0	41.3	331.3± 73.9	28.9
Nematodes	131.6± 22.4	16.0	172.7± 50.8	16.9	122.7± 30.1	11.6	114.9± 23.5	21.4	352.6± 65.6	16.7	219.5± 49.5	13.3	180.6± 19.9	15.7
Harpacticoids	71.4± 15.6	8.7	25.7± 7.3	2.5	155.7± 41.4	14.7	65.9± 9.2	12.3	199.3± 35.9	9.4	250.0±123.4	15.1	123.1± 14.8	10.7
Ostracods	17.4± 6.1	2.1	2.0± 1.0	<1.0	29.6± 9.7	2.8	17.2± 7.2	3.2	109.2± 58.0	5.2	251.5±150.3	15.2	47.3± 14.6	4.1
Worms	68.1± 52.1	8.3	7.0± 3.5	<1.0	8.6± 1.6	<1.0	14.3± 5.8	2.7	17.4± 6.5	<1.0	7.5± 2.2	<1.0	26.2± 12.8	2.3
Amphipods	18.5± 4.7	2.2	10.3± 4.6	1.0	33.8± 12.1	3.2	8.9± 2.3	1.7	42.6± 19.1	2.0	1.5± 1.0	<1.0	24.9± 5.5	2.2
Calanoids	24.8± 6.2	3.0	4.7± 1.2	<1.0	14.0± 2.9	1.3	25.7± 7.7	4.8	24.8± 6.0	1.2	14.5± 3.3	<1.0	21.2± 2.7	1.9
Cladocerans	10.6± 4.5	1.3	1.7± 0.8	<1.0	7.4± 3.7	<1.0	21.0± 8.2	3.9	35.5± 11.8	1.7	3.0± 1.3	<1.0	17.1± 3.6	1.5
Mysids	12.0± 2.8	1.5	-	-	13.1± 5.0	1.2	1.3± 0.6	<1.0	7.1± 4.3	<1.0	-	-	8.0± 1.7	<1.0
Isopods	4.6± 1.3	<1.0	35.3± 15.8	3.5	9.7± 2.9	<1.0	4.5± 1.2	<1.0	7.9± 2.5	<1.0	2.5± 1.0	<1.0	7.8± 1.3	<1.0
Ectoprocts	4.3± 1.5	<1.0	39.3± 28.5	3.8	3.2± 1.6	<1.0	1.9± 0.6	<1.0	10.1± 3.5	<1.0	1.0± 1.0	<1.0	6.2+ 1.6	<1.0
Acarinans	2.9± 0.5	<1.0	9.7± 4.1	<1.0	4.1± 1.0	<1.0	3.4± 0.7	<1.0	6.3± 2.1	<1.0	11.5± 3.5	<1.0	4.6± 0.6	<1.0
Polychaetes	4.1± 1.4	<1.0	<1.0	<1.0	1.0± 0.4	<1.0	7.9± 3.2	1.5	2.4± 0.9	<1.0	-	-	3.5± 0.8	<1.0
Barnacle nauplii	3.2± 2.7	<1.0	<1.0	<1.0	1.1± 0.4	<1.0	1.4± 0.7	<1.0	2.1± 1.4	<1.0	1.0± 0.6	<1.0	1.9± 0.8	<1.0
Insects	<1.0	<1.0	-	-	1.5± 0.7	<1.0	<1.0	<1.0	5.1± 1.9	<1.0	-	-	1.8± 0.5	<1.0
Gastropod eggs	2.0± 0.6	<1.0	-	-	1.6± 0.5	<1.0	<1.0	<1.0	1.7± 0.6	<1.0	1.0± 0.6	<1.0	1.3± 0.2	<1.0
Euphausiids	-	-	-	-	<1.0	<1.0	1.1± 1.0	<1.0	<1.0	<1.0	24.5± 24.5	1.5	1.1± 0.7	<1.0
Total	825.0±223.3		1024.1±458.6		1060.6±221.0		536.4±83.3		2115.9±374.0		1653.5±545.4		1147.6±163.5	

Table 3. Mean density m^{-2} ± 1SE and percent of total population of dominant harpacticoid species at six stations and all stations combined in the Campbell River estuarine zone 1983.

Station No.	1		3		7		11		17		18		All	
Station location	Mother Ramp		Nunn's Creek		North Baikie Mouth		Island # 1		Island #3		Island #4			
No. samples	34		6		34		30		32		4		140	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Species														
Huntemannia jadensis	13.1±3.9	18.4	2.7±1.0	10.4	21.8±7.8	14.0	14.2±3.3	21.5	154.6±30.9	77.6	193.0±98.0	77.2	52.5±9.4	42.7
Unidentified copepodites	30.1±6.2	42.1	14.0±4.4	54.6	56.8±17.0	36.5	29.7±5.5	45.0	21.3±4.9	10.7	43.0±22.0	17.2	34.1±4.8	27.8
Family Ectinosomatidae	7.6±2.3	10.6	4.0±2.7	15.6	50.0±16.8	32.1	5.5±1.8	8.3	5.1±1.9	2.5	1.5±1.5	<1.0	16.5±4.4	13.4
Mesochra alaskana	-	-	<1.0	1.2	5.7±3.4	3.7	4.8±2.5	7.3	<1.0	<1.0	-	-	2.5±1.0	2.0
Mesochra species	0.7±0.5	1.0	-	-	7.6±6.2	4.9	<1.0	1.2	-	-	-	-	2.2±1.5	1.8
Tisbe species	4.1±1.3	5.8	2.3±1.5	9.1	1.2±0.6	<1.0	<1.0	<1.0	1.4±0.8	<1.0	-	-	1.8±0.4	1.5
Zaus species	<1.0	<1.0	-	-	<1.0	<1.0	<1.0	<1.0	7.3±5.3	3.6	-	-	1.7±1.2	1.4
Harpacticus species	1.8±0.9	2.6	-	-	1.6±0.9	1.0	<1.0	<1.0	3.6±2.6	1.8	-	-	1.7±0.7	1.4
Tachidius discipes	<1.0	<1.0	-	-	2.9±2.2	1.9	1.6±0.6	2.4	<1.0	<1.0	6.5±6.5	2.6	1.5±0.6	1.2
Sarsameira species "B"	1.9±0.5	2.7	-	-	2.1±0.7	1.4	<1.0	<1.0	1.2±0.6	<1.0	-	-	1.3±0.3	1.1
Microarthridion littorale	1.4±0.6	1.9	<1.0	1.2	<1.0	<1.0	2.9±1.2	4.5	<1.0	<1.0	-	-	1.2±0.3	1.0
Asphiascoides species	2.6±1.3	3.6	-	-	-	-	-	-	-	-	-	-	<1.0	<1.0
Heterolaophonte hamondi	1.6±1.1	2.2	-	-	-	-	-	-	-	-	-	-	<1.0	<1.0
Heterolaophonte discophora	1.5±1.4	2.1	-	-	<1.0	<1.0	-	-	-	-	-	-	<1.0	<1.0
Heterolaophonte longisetigera	1.4±0.9	2.0	-	-	<1.0	<1.0	-	-	-	-	-	-	<1.0	<1.0
Nitocra spinipes	<1.0	<1.0	1.0±0.7	3.9	<1.0	<1.0	2.1±0.9	3.2	1.4±0.6	<1.0	<1.0	<1.0	1.0±0.2	<1.0
Laophonte foxi	<1.0	<1.0	<1.0	1.2	-	-	<1.0	<1.0	-	-	-	-	<1.0	<1.0
Rosanea arenicola	-	-	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	<1.0	<1.0
Mesochra pygmea	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	-	-	-	-	-	-	<1.0	<1.0
Onychocamptus mohammed	<1.0	<1.0	-	-	<1.0	<1.0	<1.0	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Schizopera knabeni	<1.0	<1.0	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.5±1.5	1.0	<1.0	<1.0
Mesochra rapiens	<1.0	<1.0	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.5±1.5	1.0	<1.0	<1.0
Total	71.4±15.6		25.7±7.3		155.7±41.4		65.9±9.2		199.3±35.9		250.0±123.4		123.1±14.8	

Table 4. Dominant food items in juvenile chinook stomachs in the Campbell River estuarine zone 1983.

Station	1			1			7			7			14,15,16,17,141,151		
Wild or Marked	Wild			Marked			Wild			Marked			Wild		
Dates	27 Jan. - 7 Sept.			27 Jan. - 8 June			26 Jan. - 9 Nov.			23 Feb. - 2 Aug.			22 Feb. - 8 Nov.		
No. fish analyzed	48			79			40			67			35		
Range in length (mm)	36 - 176			73 - 193			33 - 178			58 - 152			35 - 185		
Range in weight (gm)	0.3 - 77.0			4.6 - 90.7			0.3 - 74.2			2.3 - 43.3			0.3 - 85.8		
Number stomachs empty	0			3			7			7			6		
Food group	Numerical percent	% Freq. occur.	x # per Fish	Numerical percent	% Freq. occur.	x # per Fish	Numerical percent	% Freq. occur.	x # per Fish	Numerical percent	% Freq. occur.	x # per Fish	Numerical percent	% Freq. occur.	x # per Fish
Pelagic calanoids and cyclopoids	3.8	33.3	6.3	12.9	65.8	18.9	40.5	25.0	35.9	31.2	37.3	29.3	82.2	68.6	68.0
Juvenile and adult insects	2.9	70.8	5.2	<1.0	39.2	1.1	14.2	62.5	12.6	4.9	41.8	4.6	2.9	40.0	2.4
Epibenthic amphipods	6.5	45.8	11.7	2.0	43.0	2.9	5.2	35.0	4.6	2.8	34.3	2.7	2.2	40.0	1.8
Epibenthic harpacticoids	4.9	29.2	8.8	4.7	45.6	6.9	<1.0	2.5	<1.0	1.4	13.4	1.3	2.1	20.0	1.7
Freshwater cladocera	73.5	50.0	132.0	68.4	48.1	100.1	18.0	37.5	16.0	50.6	38.8	47.4	2.8	20.0	2.3
Pelagic amphipods	<1.0	10.4	<1.0	1.1	26.6	1.6	<1.0	10.0	<1.0	<1.0	13.4	<1.0	<1.0	14.3	<1.0
Decapod larvae	<1.0	2 1	<1.0	2.6	41.8	3.8	<1.0	2.5	<1.0	1.8	9.0	1.7	5.9	28.6	4.9
Epibenthic cumaceans	<1.0	6.3	<1.0	6.1	20.3	8.9	<1.0	7.5	<1.0	<1.0	1.5	<1.0	-	-	-
Epibenthic isopods	6.9	14.6	12.4	<1.0	19.0	<1.0	3.3	10.0	2.9	1.0	25.4	<1.0	<1.0	2.9	<1.0
Pelagic cirripede larvae	<1.0	12.5	1.4	<1.0	26.6	1.1	8.0	10.0	7.0	3.8	10.5	3.6	<1.0	11.4	<1.0
Herring eggs	-	-	-	-	-	-	6.5	2.5	5.8	-	-	-	-	-	-
Gastropods	<1.0	6.3	<1.0	<1.0	5.1	<1.0	1.0	12.5	<1.0	<1.0	4.5	<1.0	<1.0	5.7	<1.0

Table 5. Mean density m^{-2} ± 1SE and percent of total population of dominant epibenthos at station North Baikie Mouth (7) and Island Three (17) for all common sampling periods, and for all stations combined in the Campbell River estuarine zone 1982 and 1983.

Location	North Baikie Mouth (7)				Island Three (17)				Estuarine Zone			
Year	1982		1983		1982		1983		1982		1983	
Dates	23 Mar.-14 Dec.		27 Jan.-6 Dec.		23 Mar.-3 May		15 Mar.-5 May		23 Mar.-14 Dec.		26 Jan.-7 Dec.	
No. samples	30		34		8		8		70		140	
Taxa	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%
Copepod nauplii	170.9±43.1	40.2	247.1± 58.4	23.3	98.0±21.9	37.8	1925.8±1079.2	43.9	199.3±44.1	35.5	331.3± 73.9	28.9
Nematodes	88.1±17.1	20.7	122.7± 30.1	11.6	51.3±12.4	19.8	363.8± 130.5	8.3	175.2±33.3	31.2	180.6± 19.9	15.7
Harpacticoids	84.5±22.3	19.9	155.7± 41.4	14.7	13.5± 3.3	5.2	126.5± 64.4	2.9	96.0±22.4	17.1	123.1± 14.8	10.7
Calanoids	8.3± 1.4	2.0	14.0± 2.9	1.3	27.3± 4.9	10.5	20.3± 4.6	<1.0	14.7± 2.9	2.6	21.2± 2.7	1.8
Eggs	7.0± 1.5	1.7	403.1±197.2	38.0	18.3± 8.3	7.0	1792.5± 925.6	40.8	14.4± 3.6	2.6	336.5± 90.7	29.3
Worms	11.2± 2.2	2.6	8.6± 1.6	<1.0	16.3± 6.4	6.3	6.5± 1.9	<1.0	12.0± 1.7	2.1	26.2± 12.8	2.3
Ostracods	14.8± 4.5	3.5	29.6± 9.7	2.8	1.5± 1.0	<1.0	80.5± 66.0	1.8	10.7± 2.6	1.9	47.3± 14.6	4.1
Amphipods	11.6± 3.6	2.7	33.8± 12.1	3.2	5.5± 4.1	2.1	8.3± 3.7	<1.0	8.6± 1.7	1.5	24.9± 5.5	2.2
Cladocerans	4.1± 1.6	<1.0	7.4± 3.7	<1.0	1.3± 0.4	<1.0	16.8± 5.3	<1.0	4.9± 1.4	<1.0	17.1± 3.6	1.5
Barnacle nauplii	2.0± 0.9	<1.0	1.1± 0.4	<1.0	20.5± 9.5	7.9	6.5± 5.7	<1.0	4.5± 1.4	<1.0	1.9± 0.8	<1.0
Total	425.0±70.4		1060.6±221.0		259.3±35.9		4391.5±2094.6		561.6±92.4		1147.5±163.0	

Table 6. Mean density m^{-2}±1SE and percent of total population of dominant harpacticoid species at station North Baikie Mouth (7) and for all stations combined in the Campbell River estuarine zone 1982 and 1983.

Location	North Baikie Mouth (7)				Estuarine Zone			
Year	1982		1983		1982		1983	
Dates	23 Mar.-14 Dec.		27 Jan.-6 Dec.		23 Mar.-14 Dec.		26 Jan.-7 Dec.	
No. samples	30		34		70		140	
Species	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} +1SE	%
Unidentified copepodites	32.8± 8.3	38.8	56.8±17.0	36.5	44.2±10.5	46.0	34.1± 4.8	27.7
Huntemannia jadensis	12.7± 6.1	15.0	21.8± 7.8	14.0	21.3± 7.9	22.2	52.5± 9.4	42.7
Family Ectinosomatidae	11.0± 3.8	13.0	50.0±16.8	32.1	9.3± 2.7	9.7	16.5± 4.4	13.4
Tisbe species	10.7± 4.9	12.7	1.2± 0.6	<1.0	5.6± 2.2	5.8	1.8± 0.4	1.5
Zaus species	5.5± 4.4	6.5	<1.0	<1.0	2.7± 1.9	2.8	1.7± 1.2	1.4
Mesochra alaskana	2.3± 1.2	2.7	5.7± 3.4	3.7	1.8± 0.6	1.9	2.5± 1.0	2.0
Harpacticus species	1.5± 0.6	1.8	1.6± 0.9	1.0	1.5± 0.7	1.6	1.7± 0.7	1.4
Leimia vaga	<1.0	1.1	1.1± 0.4	<1.0	<1.0	<1.0	<1.0	<1.0
Tachidius discipes	<1.0	<1.0	2.9± 2.2	1.9	<1.0	<1.0	1.5± 0.6	1.2
Mesochra species	-	-	7.6± 6.2	4.9	<1.0	<1.0	2.2± 1.5	1.8
Sarsameira sp. "B"	<1.0	<1.0	2.1± 0.7	1.4	<1.0	<1.0	1.3± 0.3	1.1
Microarthridion littorale	<1.0	<1.0	<1.0	<1.0	3.6± 1.7	3.8	1.2± 0.8	1.0
Total	84.5±22.3		155.7±41.4		96.0±22.4		123.1±14.8	

Table 7. Dominant food items as a percent of total diet in juvenile chinook stomachs in the Campbell River estuarine zone 1982 and 1983.

Station	1		1		7		7		14-15‡		Mean			
Wild or marked	Wild		Marked		Wild		Marked		Wild		Wild		Marked	
Dates	-	27 Jan-7 Sept	-	27 Jan-8 June	24 Mar-8 Sept	26 Jan-9 Nov	10 May-27 Sept	23 Feb-2 Aug	15 Apr-17 June	22 Feb-8 Nov	24 Mar-8 Sept	26 Jan-9 Nov	10 May-27 Sept	27 Jan-2 Aug
Year	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
No. analyzed	-	48	-	79	39	40	43	67	24	35	63	123	43	146
Range in length (mm)	-	36-176	-	73-193	37-97	33-178	61-125	58-152	40-65	35-185	37-97	33-185	61-125	58-193
Range in weight (gm)	-	0.30-77.00	-	4.60-80.70	0.45-11.80	0.30-74.20	2.95-24.40	2.30-43.30	0.65-2.60	0.30-85.80	0.45-11.80	0.30-85.80	2.95-24.40	2.30-80.70
Number stomachs empty	-	0	-	3	1	7	13	7	1	6	2	13	13	10
Food group														
Pelagic calanoids and cyclopoids	-	3.8	-	12.9	19.7	40.5	63.9	31.2	47.4	82.2	32.6	27.5	63.9	19.4
Juvenile and adult insects	-	2.9	-	<1.0	47.8	14.2	6.0	4.9	4.1	2.9	27.4	5.6	6.0	2.2
Epibenthic amphipods	-	6.5	-	2.0	7.0	5.2	11.5	2.8	10.5	2.2	8.6	5.4	11.5	2.3
Epibenthic harpacticoids	-	4.9	-	4.7	5.5	<1.0	1.1	1.4	27.2	2.1	15.6	3.2	1.1	3.5
Freshwater cladocera	-	73.5	-	68.4	18.1	18.0	4.0	50.6	5.4	2.8	12.2	46.8	4.0	62.1
Pelagic amphipods	-	<1.0	-	1.1	<1.0	<1.0	2.4	<1.0	2.5	<1.0	1.2	<1.0	2.4	<1.0
Epibenthic isopods	-	6.9	-	<1.0	<1.0	3.3	6.5	1.0	-	<1.0	<1.0	4.8	6.5	<1.0
Decapod larvae	-	<1.0	-	2.6	<1.0	<1.0	1.8	1.8	<1.0	5.9	<1.0	1.3	1.8	2.3
Epibenthic ostracods	-	-	-	-	<1.0	-	<1.0	-	1.4	-	<1.0	-	<1.0	-
Epibenthic cumaceans	-	<1.0	-	6.1	-	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0	3.9
Pelagic cirripede larvae	-	<1.0	-	<1.0	-	8.0	-	3.8	-	<1.0	-	2.4	-	1.8
Herring eggs	-	-	-	-	-	6.5	-	-	-	-	-	1.5	-	-
Gastropods	-	<1.0	-	<1.0	-	1.0	<1.0	<1.0	-	<1.0	-	<1.0	<1.0	<1.0

Table 8. Mean density m^{-2} ± 1SE and percent of total population of dominant epibenthos at two stations and all stations combined in the Campbell River transition zone 1983.

Station No.	20		34		All	
Station location	Boat Ramp		Painters Channel			
No. samples	32		14		46	
	$\bar{x}\ m^{-2}$ ± 1SE	%	$\bar{x}\ m^{-2}$ ± 1SE	%	$\bar{x}\ m^{-2}$ ± 1SE	%
Taxa						
Copepod nauplii	616.1 ± 111.1	18.5	810.7 ± 166.4	37.8	675.3 ± 92.4	22.7
Amphipods	889.9 ± 316.9	26.7	33.9 ± 14.7	1.4	629.3 ± 227.2	21.2
Harpacticoids	629.9 ± 139.9	18.9	446.3 ± 89.3	20.8	574.0 ± 101.2	19.3
Eggs	478.6 ± 160.1	14.4	367.4 ± 145.3	17.1	444.7 ± 119.1	15.0
Nematodes	264.8 ± 127.6	8.0	203.7 ± 40.7	9.5	246.2 ± 89.2	8.3
Calanoids	196.7 ± 36.3	5.9	77.6 ± 22.7	3.6	160.4 ± 27.3	5.4
Barnacle nauplii	40.6 ± 12.3	1.2	46.1 ± 24.7	2.2	42.3 ± 11.2	1.4
Gastropod eggs	35.6 ± 8.5	1.1	35.3 ± 15.1	1.6	35.5 ± 7.4	1.2
Ectoprocts	28.5 ± 6.2	<1.0	10.1 ± 5.5	<1.0	22.9 ± 4.8	<1.0
Tunicates	27.8 ± 13.1	<1.0	1.1 ± 0.6	<1.0	19.7 ± 9.3	<1.0
Polychaetes	21.1 ± 3.8	<1.0	11.4 ± 3.0	<1.0	18.1 ± 2.9	<1.0
Ostracods	13.1 ± 2.7	<1.0	23.7 ± 8.7	1.1	16.3 ± 3.3	<1.0
Worms	15.8 ± 6.5	<1.0	15.1 ± 3.0	<1.0	15.6 ± 4.6	<1.0
Cumaceans	12.3 ± 5.1	<1.0	16.7 ± 11.7	<1.0	13.6 ± 5.0	<1.0
Cladocerans	7.9 ± 3.0	<1.0	24.1 ± 13.5	1.1	12.9 ± 4.7	<1.0
Gastropods	13.8 ± 3.9	<1.0	5.3 ± 2.1	<1.0	11.2 ± 2.8	<1.0
Bivalves	10.1 ± 3.2	<1.0	7.0 ± 2.5	<1.0	9.1 ± 2.3	<1.0
Euphausiids	8.2 ± 4.7	<1.0	<1.0	<1.0	5.7 ± 3.3	<1.0
Acarinans	4.8 ± 1.5	<1.0	6.6 ± 2.6	<1.0	5.3 ± 1.3	<1.0
Medusae	3.8 ± 1.1	<1.0	-	-	2.6 ± 0.8	<1.0
Echinoderm larvae	3.6 ± 1.1	<1.0	<1.0	<1.0	2.6 ± 0.8	<1.0
Decapods	3.1 ± 1.7	<1.0	<1.0	<1.0	2.4 ± 1.2	<1.0
Isopods	1.9 ± 1.1	<1.0	1.7 ± 1.0	<1.0	1.8 ± 0.8	<1.0
Barnacle cypris	1.0 ± 0.7	<1.0	<1.0	<1.0	<1.0	<1.0
Tanaidaceans	1.0 ± 1.0	<1.0	-	-	<1.0	<1.0
Total	3331.7 ± 430.5		2146.6 ± 364.4		2971.0 ± 327.2	

Table 9. Mean density m^{-2} ± 1SE and percent of total population of dominant harpacticoid species at two stations and all stations combined in the Campbell River transition zone 1983.

Station no.	20		34		All	
Station location	Boat Ramp		Painters Channel			
No. samples	32		14		46	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Species						
Unidentified copepodites	214.3 ± 52.8	34.0	228.9 ± 49.2	51.3	218.7 ± 39.3	38.1
Zaus species	136.3 ± 58.6	21.6	1.3 ± 1.3	<1.0	95.2 ± 41.6	16.6
Tisbe species	112.3 ± 31.8	17.8	51.9 ± 12.8	11.6	93.9 ± 22.7	16.4
Harpacticus species	73.0 ± 25.0	11.6	77.0 ± 29.5	17.3	74.2 ± 19.4	12.9
Family Ectinosomatidae	39.2 ± 9.8	6.2	18.9 ± 6.7	4.2	33.0 ± 7.2	5.8
Dactylopodia species	4.5 ± 2.1	<1.0	9.6 ± 8.3	2.2	6.0 ± 2.9	1.1
Heterolaophonte hamondi	1.3 ± 1.1	<1.0	16.9 ± 7.9	3.8	6.0 ± 2.7	1.1
Microsetella species	7.4 ± 1.9	1.2	1.9 ± 1.1	<1.0	5.7 ± 1.4	<1.0
Dactylopodia crassipes	3.0 ± 1.2	<1.0	9.1 ± 7.1	2.0	4.9 ± 2.3	<1.0
Ameira longipes	6.8 ± 3.2	1.1	<1.0	<1.0	4.7 ± 2.3	<1.0
Scutellidium hippolytes	6.3 ± 2.2	1.0	-	-	4.4 ± 1.6	<1.0
Huntemannia jadensis	<1.0	<1.0	10.6 ± 6.0	2.4	3.9 ± 1.9	<1.0
Mesochra pygmaea	4.9 ± 1.6	<1.0	1.1 ± 0.8	<1.0	3.7 ± 1.1	<1.0
Heterolaophonte longisetigera	<1.0	<1.0	4.9 ± 2.1	1.1	1.9 ± 0.8	<1.0
Laophontid sp. "C"	-	-	5.0 ± 2.6	1.1	1.5 ± 0.8	<1.0
Parastenhelia spinosa	1.8 ± 1.1	<1.0	<1.0	<1.0	1.4 ± 0.8	<1.0
Amonardia perturbata	2.1 ± 1.1	<1.0	-	-	1.4 ± 0.8	<1.0
Nitocra sp. "A"	-	-	4.3 ± 2.1	<1.0	1.3 ± 0.7	<1.0
Paralaophonte pacifica	1.8 ± 1.1	1.0	-	-	1.2 ± 0.8	<1.0
Amphiascoides species	1.6 ± 0.8	<1.0	-	-	1.1 ± 0.5	<1.0
Amphiascus undosus	1.6 ± 1.1	<1.0	-	-	1.1 ± 0.8	<1.0
Porcellidium species	1.5 ± 1.1	<1.0	-	-	1.0 ± 0.8	<1.0
Idomene species	1.3 ± 1.0	<1.0	-	-	<1.0	<1.0
Laophontodes hedgpethi	1.0 ± 1.0	<1.0	-	-	<1.0	<1.0
Amphiascus minutus	1.0 ± 0.4	<1.0	-	-	<1.0	<1.0
Total	629.9 ± 139.9		446.3 ± 89.3		574.0 ± 101.2	

Table 10. Dominant food items in juvenile chinook stomachs in the Campbell River transition zone 1983.

Station	21			21		
Wild or marked	Wild			Marked		
Dates	15 Mar. - 18 Aug.			23 Apr. - 8 Jul.		
No. fish analyzed	10			51		
Range in length (mm)	38 - 187			65 - 125		
Range in weight (gm)	0.5 - 85.5			2.6 - 18.5		
Number stomachs empty	0			3		
Food group	Numerical percent	% Freq. occur.	$\bar{x}$ # per Fish	Numerical percent	% Freq. occur.	$\bar{x}$ # per Fish
Pelagic calanoids & cyclopoids	13.0	60.0	2.1	2.4	33.3	3.5
Juvenile and adult insects	5.0	60.0	<1.0	<1.0	25.5	<1.0
Epibenthic amphipods	46.0	60.0	7.4	9.6	70.6	13.9
Epibenthic harpacticoids	18.6	20.0	3.0	81.4	56.9	118.0
Pelagic amphipods	2.5	30.0	<1.0	<1.0	11.8	<1.0
Decapod larvae	9.9	20.0	1.6	1.5	17.7	2.2
Epibenthic cumaceans	-	-	-	4.0	54.9	5.8
Epibenthic isopods	-	-	-	<1.0	2.0	<1.0

Table 11. Dominant food items as a percent of total diet in juvenile chinook stomachs in the Campbell River transition zone 1982 and 1983.

Station	4		5		5		20		20			21		21		34		Mean			
Wild or marked	Marked		Wild		Marked		Wild		Marked			Wild		Marked		Marked		Wild		Marked	
Dates	29 May-17 July		21 July		29 May-9 July		17 May-9 Sept.		18 May-9 Sept.			15 Mar.-18 Aug.		23 Apr.-8 July		28 May-21 July		17 May-9 Sept.	15 Mar.-18 Aug.	18 May-9 Sept.	23 Apr.-8 July
Year	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1983	1982	1983
No. analyzed	19	-	5	-	10	-	20	-	15	-	-	10	-	51	12	-	25	10	56	51	
Range in length (mm)	76-110	-	74-84	-	85-109	-	45-132	-	64-161	-	-	38-187	-	65-125	76-111	-	45-132	38-187	64-161	65-125	
Range in weight (gm)	5.30-14.90	-	5.10-7.40	-	8.20-15.10	-	1.00-24.50	-	3.50-50.80	-	-	0.50-85.50	-	2.60-18.50	5.20-16.60	-	1.00-24.50	0.50-85.50	3.50-50.80	2.60-18.50	
Number stomachs empty	3	-	0	-	5	-	0	-	4	-	-	0	-	3	0	-	0	0	12	3	
Food group																					
Pelagic calanoids and cyclopoids	78.3	-	-	-	33.0	-	11.5	-	62.5	-	-	13.0	-	2.4	25.1	-	1.5	13.0	42.5	2.4	
Juvenile and adult insects	<1.0	-	<1.0	-	-	-	10.1	-	1.0	-	-	5.0	-	<1.0	<1.0	-	1.4	5.0	<1.0	<1.0	
Epibenthic amphipods	7.2	-	<1.0	-	58.9	-	5.4	-	3.1	-	-	46.0	-	9.6	4.6	-	1.2	46.0	6.9	9.6	
Epibenthic harpacticoids	3.5	-	37.5	-	-	-	65.6	-	9.5	-	-	18.6	-	81.4	54.0	-	93.3	18.6	35.2	81.4	
Pelagic amphipods	<1.0	-	-	-	-	-	2.1	-	4.3	-	-	2.5	-	<1.0	<1.0	-	<1.0	2.5	<1.0	<1.0	
Pelagic euphausiids	<1.0	-	-	-	-	-	2.6	-	15.5	-	-	-	-	<1.0	-	-	<1.0	-	1.5	<1.0	
Epibenthic cumaceans	3.4	-	1.9	-	2.5	-	1.4	-	1.0	-	-	-	-	4.0	15.8	-	1.8	-	10.8	4.0	
Epibenthic ostracods	2.1	-	<1.0	-	-	-	<1.0	-	2.4	-	-	<1.0	-	-	-	-	<1.0	<1.0	<1.0	-	
Decapod larvae	3.9	-	-	-	-	-	<1.0	-	<1.0	-	-	9.9	-	1.5	<1.0	-	<1.0	9.9	1.0	1.5	
Epibenthic isopods	<1.0	-	-	-	5.1	-	-	-	-	-	-	-	-	<1.0	<1.0	-	-	-	<1.0	<1.0	

Table 12. Mean density m^{-2} ± 1SE and percent of total population of dominant epibenthos at two stations and all stations combined in the Campbell River marine zone 1983.

Station No.	27		31		All	
Station location	Outer Gowlland		Plumper Bay			
No. samples	32		24		56	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Taxa						
Harpacticoids	133.3 ± 27.7	6.9	12162.4 ± 5992.5	56.0	5288.6 ± 2660.9	50.8
Copepod nauplii	539.8 ± 107.3	28.0	5205.3 ± 1566.6	24.0	2539.3 ± 735.2	24.4
Eggs	824.7 ± 276.2	42.7	1430.3 ± 564.5	6.6	1084.3 ± 288.6	10.4
Amphipods	13.0 ± 4.6	<1.0	1619.3 ± 645.2	7.5	701.4 ± 293.4	6.7
Calanoids	222.8 ± 23.9	11.5	495.3 ± 106.3	2.3	339.6 ± 50.4	3.3
Nematodes	27.5 ± 5.2	1.4	292.3 ± 162.9	1.3	141.0 ± 71.3	1.4
Gastropod eggs	16.4 ± 2.5	<1.0	211.8 ± 59.2	<1.0	100.1 ± 28.3	<1.0
Tunicates	50.1 ± 17.3	2.6	34.2 ± 12.3	<1.0	43.3 ± 11.2	<1.0
Barnacle nauplii	22.6 ± 3.6	1.2	55.8 ± 18.3	<1.0	36.9 ± 8.3	<1.0
Polychaetes	12.4 ± 3.0	<1.0	37.5 ± 9.2	<1.0	23.2 ± 4.5	<1.0
Ostracods	12.0 ± 5.7	<1.0	28.9 ± 8.6	<1.0	19.3 ± 5.0	<1.0
Ectoprocts	18.7 ± 5.1	<1.0	19.7 ± 13.5	<1.0	19.1 ± 6.4	<1.0
Bivalves	6.0 ± 1.8	<1.0	33.3 ± 17.0	<1.0	17.7 ± 7.5	<1.0
Gastropods	4.3 ± 0.9	<1.0	21.3 ± 8.8	<1.0	11.6 ± 3.9	<1.0
Worms	4.3 ± 1.1	<1.0	16.2 ± 5.6	<1.0	9.4 ± 2.6	<1.0
Isopods	<1.0	<1.0	20.7 ± 11.2	<1.0	9.2 ± 4.9	<1.0
Acarinans	2.6 ± 0.6	<1.0	9.6 ± 5.3	<1.0	5.6 ± 2.3	<1.0
Cladocerans	5.5 ± 2.6	<1.0	4.4 ± 1.8	<1.0	5.0 ± 1.7	<1.0
Euphausiids	2.8 ± 1.1	<1.0	8.0 ± 3.3	<1.0	5.0 ± 1.6	<1.0
Echinoderm larvae	6.3 ± 2.1	<1.0	2.2 ± 1.1	<1.0	4.5 ± 1.3	<1.0
Cumaceans	<1.0	<1.0	8.5 ± 3.0	<1.0	3.9 ± 1.4	<1.0
Medusae	2.3 ± 0.8	<1.0	2.3 ± 0.7	<1.0	2.3 ± 0.5	<1.0
Decapods	1.0 ± 0.6	<1.0	3.1 ± 1.9	<1.0	1.9 ± 0.9	<1.0
Barnacle cypris	<1.0	<1.0	1.8 ± 1.3	<1.0	<1.0	<1.0
Insects	<1.0	<1.0	1.4 ± 0.8	<1.0	<1.0	<1.0
Total	1931.1 ± 306.1		21727.2 ± 6941.9		10415.1 ± 3226.7	

Table 13. Mean density m^{-2} ± 1SE and percent of total population of dominant harpacticoid species at two stations and all stations combined in the Campbell River marine zone 1983.

Station no.	27		31		All	
Station location	Outer Gowlland		Plumper Bay			
No. samples	32		24		56	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Species						
Tisbe species	20.1 ± 4.4	15.1	6413.3 ± 3576.3	52.7	2760.0 ± 1572.9	52.2
Unidentified copepodites	67.4 ± 17.7	50.6	4480.3 ± 2148.6	36.8	1958.6 ± 956.1	37.0
Family Ectinosomatidae	7.4 ± 2.4	5.6	482.6 ± 142.2	4.0	211.0 ± 68.1	4.0
Amonardia perturbata	<1.0	<1.0	164.0 ± 77.7	1.4	70.6 ± 34.7	1.3
Harpacticus species	8.3 ± 3.4	6.2	126.2 ± 53.7	1.0	58.8 ± 24.1	1.1
Mesochra pygmaea	3.6 ± 1.4	2.7	107.8 ± 73.7	<1.0	48.3 ± 32.0	<1.0
Diosaccus spinatus	<1.0	<1.0	106.3 ± 58.0	<1.0	46.0 ± 25.5	<1.0
Heterolaophonte longisetigera	<1.0	<1.0	74.3 ± 42.1	<1.0	32.3 ± 18.5	<1.0
Dactylopodia vulgaris	2.1 ± 1.4	1.6	56.1 ± 25.3	<1.0	25.3 ± 11.3	<1.0
Microsetella species	4.2 ± 0.9	3.2	44.0 ± 34.4	<1.0	21.3 ± 14.8	<1.0
Zaus species	5.3 ± 1.9	4.0	19.3 ± 12.4	<1.0	11.3 ± 5.4	<1.0
Parastenhelia spinosa	1.2 ± 0.7	<1.0	13.1 ± 6.2	<1.0	6.3 ± 2.8	<1.0
Scutellidium hippolytes	<1.0	<1.0	14.1 ± 9.2	<1.0	6.1 ± 4.0	<1.0
Amphiascopsis cinctus	<1.0	<1.0	9.8 ± 6.8	<1.0	4.3 ± 2.9	<1.0
Paralaophonte perplexa	<1.0	<1.0	9.6 ± 6.6	<1.0	4.1 ± 2.9	<1.0
Diarthrodes species	1.9 ± 0.9	1.4	4.9 ± 3.6	<1.0	3.2 ± 1.6	<1.0
Scutellidium arthuri	-	-	7.2 ± 6.1	<1.0	3.1 ± 2.6	<1.0
Huntemannia jadensis	1.4 ± 0.7	1.1	4.0 ± 2.7	<1.0	2.5 ± 1.2	<1.0
Ameira longipes	<1.0	<1.0	4.1 ± 2.4	<1.0	2.1 ± 1.0	<1.0
Nitocra spinipes	1.5 ± 0.6	1.1	2.6 ± 1.8	<1.0	2.0 ± 0.8	<1.0
Ameira species	<1.0	<1.0	3.5 ± 3.5	<1.0	1.8 ± 1.5	<1.0
Scutellidium species	<1.0	<1.0	3.9 ± 3.9	<1.0	1.7 ± 1.7	<1.0
Dactylopodia crassipes	<1.0	<1.0	3.5 ± 3.5	<1.0	1.6 ± 1.5	<1.0
Amphiascoides species	<1.0	<1.0	2.3 ± 1.9	<1.0	1.4 ± 0.8	<1.0
Heterolaophonte discophora	1.1 ± 0.9	<1.0	<1.0	<1.0	<1.0	<1.0
Microarthridion littorale	-	-	2.2 ± 0.8	<1.0	<1.0	<1.0
Total	133.3 ± 27.7		12162.4 ± 5992.5		5288.6 ± 2660.9	

Table 14. Dominant food items in juvenile chinook stomachs in the Campbell River marine zone 1983.

Station	25
Wild or marked	Wild
Dates	8 May - 17 June
No. fish analyzed	14
Range in length (mm)	51 - 74
Range in weight (gm)	1.0 - 4.8
Number stomachs empty	1

Food group	Numerical percent	% Freq. occur.	$\bar{x}$ # per Fish
Pelagic calanoids and cyclopoids	3.0	50.0	7.2
Juvenile and adult insects	1.1	64.3	2.7
Epibenthic amphipods	1.7	78.6	4.1
Epibenthic harpacticoids	62.2	85.7	147.6
Pelagic amphipods	<1.0	14.3	<1.0
Decapod larvae	7.8	14.3	18.5
Epibenthic cumaceans	<1.0	35.7	<1.0
Pelagic cirripede larvae	23.6	64.3	56.1

Table 15. Mean density m^{-2}±1SE and percent of total population of dominant epibenthos at stations Outer Gowlland (27) and Plumper Bay (31) and for all stations combined in the Campbell River marine zone 1982 and 1983.

Location	Outer Gowlland (27)				Plumper Bay (31)				Marine Zone			
Year	1982		1983		1982		1983		1982		1983	
Dates	23 Mar.-29 Sept.		15 Mar.-7 Dec.		6 Apr.-9 Sept.		13 Apr.-4 Oct.		23 Mar.-29 Sept.		15 Mar.-7 Dec.	
No. samples	28		32		24		24		64		56	
	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%
Taxa												
Harpacticoids	735.2±224.5	23.6	133.3± 27.7	6.9	5114.2±2438.9	41.2	12162.4±5992.5	56.0	3836.6±1258.0	38.9	5288.6±2660.9	50.8
Copepod nauplii	1098.0*±146.5	35.2*	539.8±107.3	28.0	4920.8*±2348.2	39.7*	5205.3±1566.6	24.0	3792.2±1206.1	38.4	2539.3± 735.2	24.4
Amphipods	133.4± 76.8	4.3	13.0± 4.6	<1.0	885.3± 322.6	7.1	1619.3± 645.2	7.5	886.1± 311.7	9.0	701.4± 293.4	6.7
Calanoids	394.7± 69.2	12.6	222.8± 23.9	11.5	378.5± 70.0	3.1	495.3± 106.3	2.3	351.0± 41.8	3.6	339.6± 50.4	3.3
Eggs	100.9± 28.9	3.2	824.7±276.2	42.7	280.8± 93.8	2.3	1430.3± 564.5	6.6	175.3± 39.7	1.8	1084.3± 288.6	10.4
Tunicates	334.1±158.7	10.7	50.1± 17.3	2.6	51.1± 19.6	<1.0	34.2± 12.3	<1.0	167.5± 71.6	1.7	43.3± 11.2	<1.0
Nematodes	74.1± 16.9	2.4	27.5± 5.2	1.4	177.3± 50.6	1.4	292.3± 162.9	1.3	165.0± 37.0	1.7	141.0± 71.3	1.4
Barnacle nauplii	38.1± 10.2	1.2	22.6± 3.6	1.2	35.0± 17.1	<1.0	55.8± 18.3	<1.0	136.3± 73.6	1.4	36.9± 8.3	<1.0
Gastropod eggs	20.0± 2.4	<1.0	16.4± 2.5	<1.0	298.2± 70.4	2.4	211.8± 59.2	<1.0	130.0± 30.9	1.3	100.1± 28.3	<1.0
Total	3122.1±416.2		1931.1±306.1		12400.2±4881.4		21727.2±6941.9		9876.2±2691.0		10415.1±3226.7	

*Denotes calculated value included.

Table 16. Mean density m^{-2}±1SE and percent of total population of dominant harpacticoid species at stations Outer Gowlland (27) and Plumper Bay (31) and for all stations combined in the Campbell River marine zone 1982 and 1983.

Location	Outer Gowlland (27)				Plumper Bay (31)				Marine zone			
Year	1982		1983		1982		1983		1982		1983	
Dates	23 Mar.-29 Sept.		15 Mar.-7 Dec.		6 Apr.-9 Sept.		13 Apr.-4 Oct.		23 Mar.-29 Sept.		15 Mar.-7 Dec.	
No. samples	28		32		24		24		64		56	
	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%	$\bar{x}$ m^{-2} ±1SE	%
Species												
Tisbe species	302.7±127.8	41.2	20.1± 4.4	15.1	3255.3±1975.7	63.7	6413.3±3576.3	52.7	1915.8± 814.0	49.9	2760.0±1572.9	52.2
Unidentified copepodites	249.5± 70.3	34.0	67.4±17.7	50.6	1302.8± 387.8	25.5	4480.3±2148.6	36.8	1313.0± 440.8	34.2	1958.6± 956.1	37.0
Family Ectinosomatidae	14.2± 3.7	1.9	7.4± 2.4	5.6	254.0± 76.7	5.0	482.6± 142.2	4.0	183.4± 54.3	4.8	211.0± 68.1	4.0
Zaus species	85.6± 53.2	11.7	5.3± 1.9	4.0	9.7± 6.5	<1.0	19.3± 12.4	<1.0	88.5± 33.2	2.3	11.3± 5.4	<1.0
Harpacticus species	11.5± 3.0	1.6	8.3± 3.4	6.2	23.7± 9.3	<1.0	126.2± 53.7	1.0	70.0± 20.5	1.8	58.8± 24.1	1.1
Diasaccus spinatus	3.6± 2.3	<1.0	<1.0	<1.0	12.7± 9.7	<1.0	106.3± 58.0	<1.0	55.2± 34.5	1.4	46.0± 25.5	<1.0
Dactylopodia species	9.3± 3.0	1.3	<1.0	<1.0	43.4± 18.1	<1.0	<1.0	<1.0	41.9± 13.6	1.1	<1.0	<1.0
Mesochra pygmaea	6.0± 2.9	<1.0	3.6± 1.4	2.7	12.8± 4.8	<1.0	107.8± 73.7	<1.0	35.6± 14.7	<1.0	48.3± 32.0	<1.0
Amonardia perturbata	1.4± 1.0	<1.0	<1.0	<1.0	<1.0	<1.0	164.0± 77.7	1.4	<1.0	<1.0	70.6± 34.7	1.3
Diarthrodes species	-	-	1.9± 0.9	1.4	-	-	4.9± 3.6	<1.0	-	-	3.2± 1.6	<1.0
Microsetella species	2.8± 1.3	<1.0	4.2± 0.9	3.2	2.3± 1.8	<1.0	44.0± 34.4	<1.0	2.1± 0.9	<1.0	21.3± 14.8	<1.0
Nitocra spinipes	3.6± 2.0	<1.0	1.5± 0.6	1.1	8.4± 5.3	<1.0	2.6± 1.8	<1.0	5.4± 2.2	<1.0	2.0± 0.8	<1.0
Huntemannia jadensis	2.0± 0.9	<1.0	1.4± 0.7	1.1	13.5± 3.6	<1.0	4.0± 2.7	<1.0	6.4± 1.6	<1.0	2.5± 1.2	<1.0
Dactylopodia vulgaris	-	-	2.1± 1.4	1.6	-	-	56.1± 25.3	<1.0	-	-	25.3± 11.3	<1.0
Total	735.2±224.5		133.3±27.7		5114.2±2438.9		12162.4±5992.5		3836.6±1258.0		5288.6±2660.9	

Table 17. Dominant food items as a percent of total diet in juvenile chinook stomachs in the Campbell River marine zone 1982 and 1983.

Station	23		24		24		25		25		27		Mean			
Wild or marked	Marked		Wild		Marked		Wild		Marked		Wild		Wild		Marked	
Dates	16 June	-	20 July-4 Aug	-	20 July-4 Aug	-	8 May-17 June	-	18 June-8 July	-	4 Aug	-	20 July-4 Aug	8 May-17 June	16 June-4 Aug	-
Year	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
No. analyzed	5	-	10	-	9	-	-	14	15	-	5	-	15	14	29	-
Range in length (mm)	101-117	-	82-93	-	100-121	-	-	51-74	82-125	-	69-80	-	69-93	51-74	82-125	-
Range in weight (gm)	14.60-21.95	-	6.50-9.50	-	10.80-19.50	-	-	1.0-4.8	6.40-22.1	-	3.80-6.00	-	3.80-9.50	1.0-4.8	6.40-22.1	-
No. stomachs empty	0	-	0	-	0	-	-	1	2	-	0	-	0	1	2	-
Food group																
Pelagic calanoids and cyclopoids	94.6	-	14.2	-	3.2	-	-	3.0	22.5	-	11.4	-	13.7	3.0	35.8	-
Juvenile and adult insects	-	-	2.1	-	<1.0	-	-	1.1	2.7	-	7.4	-	3.2	1.1	1.3	-
Epibenthic amphipods	1.8	-	6.0	-	2.2	-	-	1.7	<1.0	-	15.9	-	8.0	1.7	1.3	-
Epibenthic harpacticoids	1.4	-	1.9	-	-	-	-	62.2	<1.0	-	1.7	-	1.8	62.2	<1.0	-
Pelagic euphausiids	-	-	<1.0	-	1.5	-	-	-	<1.0	-	-	-	<1.0	-	<1.0	-
Pelagic amphipods	-	-	4.8	-	16.7	-	-	<1.0	2.2	-	4.6	-	4.8	<1.0	5.8	-
Pelagic gastropods	-	-	-	-	<1.0	-	-	-	2.0	-	-	-	-	-	<1.0	-
Decapod larvae	<1.0	-	58.5	-	68.5	-	-	7.8	5.7	-	56.8	-	56.3	7.8	22.4	-
Epibenthic ostracods	1.8	-	3.4	-	6.0	-	-	-	1.1	-	-	-	2.7	-	2.7	-
Fish	<1.0	-	-	-	<1.0	-	-	-	<1.0	-	1.1	-	<1.0	-	<1.0	-
Epibenthic cumaceans	-	-	7.3	-	<1.0	-	-	<1.0	62.4	-	-	-	5.8	<1.0	27.4	-
Epibenthic tanaidaceans	-	-	1.3	-	-	-	-	-	-	-	<1.0	-	1.1	-	-	-
Pelagic cirripede larvae	-	-	-	-	-	-	-	23.6	-	-	-	-	-	23.6	-	-

Table 18. Mean density m^{-2} ± 1SE and percent of total population of dominant epibenthos at all stations combined Campbell River zonal comparison 1983.

Zone	Estuarine		Transition		Marine	
Dates	26 Jan. - 7 Dec.		22 Feb. - 6 Dec.		15 Mar. - 7 Dec.	
No. samples	140		46		56	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Taxa						
Eggs	336.5 ± 90.7	29.3	444.7 ± 119.1	15.0	1084.3 ± 288.6	10.4
Copepod nauplii	331.3 ± 73.9	28.9	675.3 ± 92.4	22.7	2539.3 ± 735.2	24.4
Nematodes	180.6 ± 19.9	15.7	246.2 ± 89.2	8.3	141.0 ± 71.3	1.4
Harpacticoids	123.1 ± 14.8	10.7	574.0 ± 101.2	19.3	5288.6 ± 2660.9	50.8
Ostracods	47.3 ± 14.6	4.1	16.3 ± 3.3	<1.0	19.3 ± 5.0	<1.0
Worms	26.2 ± 12.8	2.3	15.6 ± 4.6	<1.0	9.4 ± 2.6	<1.0
Amphipods	24.9 ± 5.5	2.2	629.3 ± 227.2	21.2	701.4 ± 293.4	6.7
Calanoids	21.2 ± 2.7	1.9	160.4 ± 27.3	5.4	339.6 ± 50.4	3.3
Cladocerans	17.1 ± 3.6	1.5	12.9 ± 4.7	<1.0	5.0 ± 1.7	<1.0
Mysids	8.0 ± 1.7	<1.0	<1.0	<1.0	<1.0	<1.0
Isopods	7.8 ± 1.3	<1.0	1.8 ± 0.8	<1.0	9.2 ± 4.9	<1.0
Ectoprocts	6.2 ± 1.6	<1.0	22.9 ± 4.8	<1.0	19.1 ± 6.4	<1.0
Acarinans	4.6 ± 0.6	<1.0	5.3 ± 1.3	<1.0	5.6 ± 2.3	<1.0
Polychaetes	3.5 ± 0.8	<1.0	18.1 ± 2.9	<1.0	23.2 ± 4.5	<1.0
Barnacle nauplii	1.9 ± 0.8	<1.0	42.3 ± 11.2	1.4	36.9 ± 8.3	<1.0
Insects	1.8 ± 0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Gastropod eggs	1.3 ± 0.2	<1.0	35.5 ± 7.4	1.2	100.1 ± 28.3	<1.0
Euphausiids	1.1 ± 0.7	<1.0	5.7 ± 3.3	<1.0	5.0 ± 1.6	<1.0
Tunicates	<1.0	<1.0	19.7 ± 9.3	<1.0	43.3 ± 11.2	<1.0
Cumaceans	<1.0	<1.0	13.6 ± 5.0	<1.0	3.9 ± 1.4	<1.0
Gastropods	<1.0	<1.0	11.2 ± 2.8	<1.0	11.6 ± 3.9	<1.0
Bivalves	<1.0	<1.0	9.1 ± 2.3	<1.0	17.7 ± 7.5	<1.0
Medusae	<1.0	<1.0	2.6 ± 0.8	<1.0	2.3 ± 0.5	<1.0
Echinoderm larvae	<1.0	<1.0	2.6 ± 0.8	<1.0	4.5 ± 1.3	<1.0
Decapods	<1.0	<1.0	2.4 ± 1.2	<1.0	1.9 ± 0.9	<1.0
Total	1147.6 ± 163.5		2971.0 ± 327.2		10415.1 ± 3226.7	

Table 19. Mean density m^{-2} ± 1SE and percent of total population of dominant harpacticoid species at all stations combined Campbell River zonal comparison 1983.

Zone	Estuarine		Transition		Marine	
Dates	26 Jan. - 7 Dec.		22 Feb. - 6 Dec.		15 Mar. - 7 Dec.	
No. samples	140		46		56	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Species						
Huntemannia jadensis	52.5 ± 9.4	42.7	3.9 ± 1.9	<1.0	2.5 ± 1.2	<1.0
Unidentified copepodites	34.1 ± 4.8	27.8	218.7 ± 39.3	38.1	1958.6 ± 956.1	37.0
Family Ectinosomatidae	16.5 ± 4.4	13.4	33.0 ± 7.2	5.8	211.0 ± 68.1	4.0
Mesochra alaskana	2.5 ± 1.0	2.0	-	-	-	-
Mesochra species	2.2 ± 1.5	1.8	-	-	<1.0	<1.0
Tisbe species	1.8 ± 0.4	1.5	93.9 ± 22.7	16.4	2760.0 ± 1572.9	52.2
Zaus species	1.7 ± 1.2	1.4	95.2 ± 41.6	16.6	11.3 ± 5.4	<1.0
Harpacticus species	1.7 ± 0.7	1.4	74.2 ± 19.4	12.9	58.8 ± 24.1	1.1
Tachidius discipes	1.5 ± 0.6	1.2	-	-	-	-
Sarsameira sp. "B"	1.3 ± 0.3	1.1	<1.0	<1.0	-	-
Microarthridion littorale	1.2 ± 0.3	1.0	-	-	<1.0	<1.0
Nitocra spinipes	1.0 ± 0.2	<1.0	<1.0	<1.0	2.0 ± 0.8	<1.0
Dactylopodia species	<1.0	<1.0	6.0 ± 2.9	1.1	<1.0	<1.0
Heterolaophonte hamondi	<1.0	<1.0	6.0 ± 2.7	1.1	<1.0	<1.0
Microsetella species	<1.0	<1.0	5.7 ± 1.4	<1.0	21.3 ± 14.8	<1.0
Dactylopodia crassipes	-	-	4.9 ± 2.3	<1.0	1.6 ± 1.5	<1.0
Ameira longipes	<1.0	<1.0	4.7 ± 2.3	<1.0	2.1 ± 1.0	<1.0
Scutellidium hippolytes	-	-	4.4 ± 1.6	<1.0	6.1 ± 4.0	<1.0
Mesochra pygmaea	<1.0	<1.0	3.7 ± 1.1	<1.0	48.3 ± 32.0	<1.0
Heterolaophonte longisetigera	<1.0	<1.0	1.9 ± 0.8	<1.0	32.3 ± 18.5	<1.0
Laophontid sp. "C"	<1.0	<1.0	1.5 ± 0.8	<1.0	<1.0	<1.0
Parastenhelia spinosa	-	-	1.4 ± 0.8	<1.0	6.3 ± 2.8	<1.0
Amonardia perturbata	<1.0	<1.0	1.4 ± 0.8	<1.0	70.6 ± 34.7	1.3
Nitocra sp. "A"	-	-	1.3 ± 0.7	<1.0	<1.0	<1.0
Paralaophonte pacifica	-	-	1.2 ± 0.8	<1.0	<1.0	<1.0
Amphiascoides species	<1.0	<1.0	1.1 ± 0.5	<1.0	1.4 ± 0.8	<1.0

Table 19 (cont'd)

Zone	Estuarine		Transition		Marine	
Dates	26 Jan. - 7 Dec.		22 Feb. - 6 Dec.		15 Mar. - 7 Dec.	
No. samples	140		46		56	
	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%	$\bar{x}$ m^{-2} ± 1SE	%
Amphiascus undosus	-	-	1.1 ± 0.8	<1.0	<1.0	<1.0
Porcellidium species	<1.0	<1.0	1.0 ± 0.8	<1.0	-	-
Diosaccus spinatus	-	-	<1.0	<1.0	46.0 ± 25.5	<1.0
Dactylopodia vulgaris	-	-	<1.0	<1.0	25.3 ± 11.3	<1.0
Amphiascopsis cinctus	-	-	<1.0	<1.0	4.3 ± 2.9	<1.0
Paralaophonte perplexa	<1.0	<1.0	<1.0	<1.0	4.1 ± 2.9	<1.0
Diarthrodes species	-	-	<1.0	<1.0	3.2 ± 1.6	<1.0
Scutellidium arthuri	-	-	<1.0	<1.0	3.1 ± 2.6	<1.0
Ameira species	-	-	<1.0	<1.0	1.8 ± 1.5	<1.0
Scutellidium species	-	-	<1.0	<1.0	1.7 ± 1.7	<1.0
Total	123.1 ± 14.8		574.0 ± 101.2		5288.6 ± 2660.9	

Fig. 1. Map of the Campbell River estuary and surrounding area showing estuarine zone (closed circles) and transition zone (open circles) stations sampled in 1983.

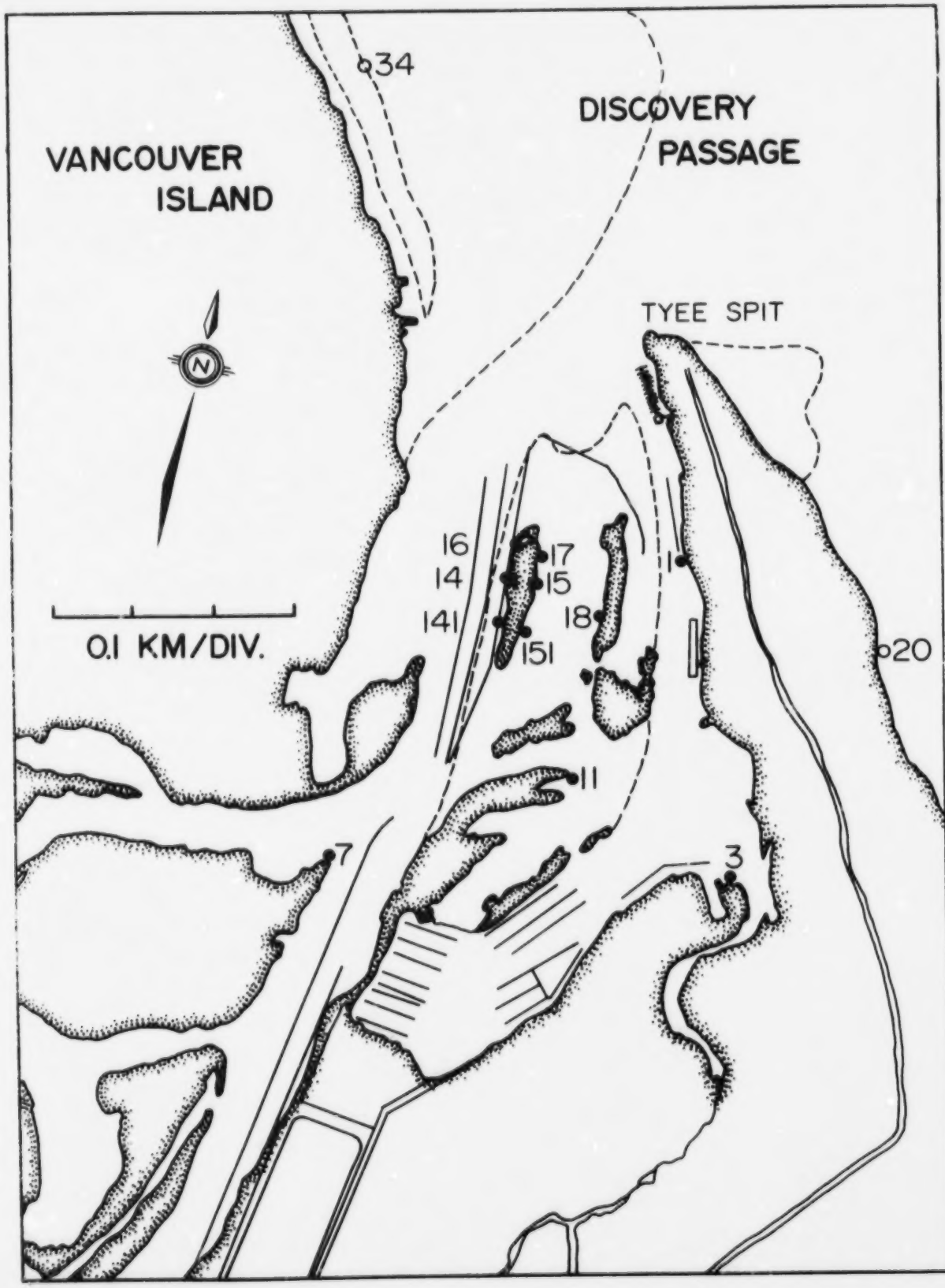

34
DISCOVERY
PASSAGE
VANCOUVER
ISLAND
TYEE SPIT
N
16
14
141
17
15
151
18
1
20
0.1 KM/DIV.
11
7
3

Fig. 2. Map of Discovery Passage and Seymour Narrows showing transition zone (open circles) and marine zone (closed triangles) stations sampled in 1983.

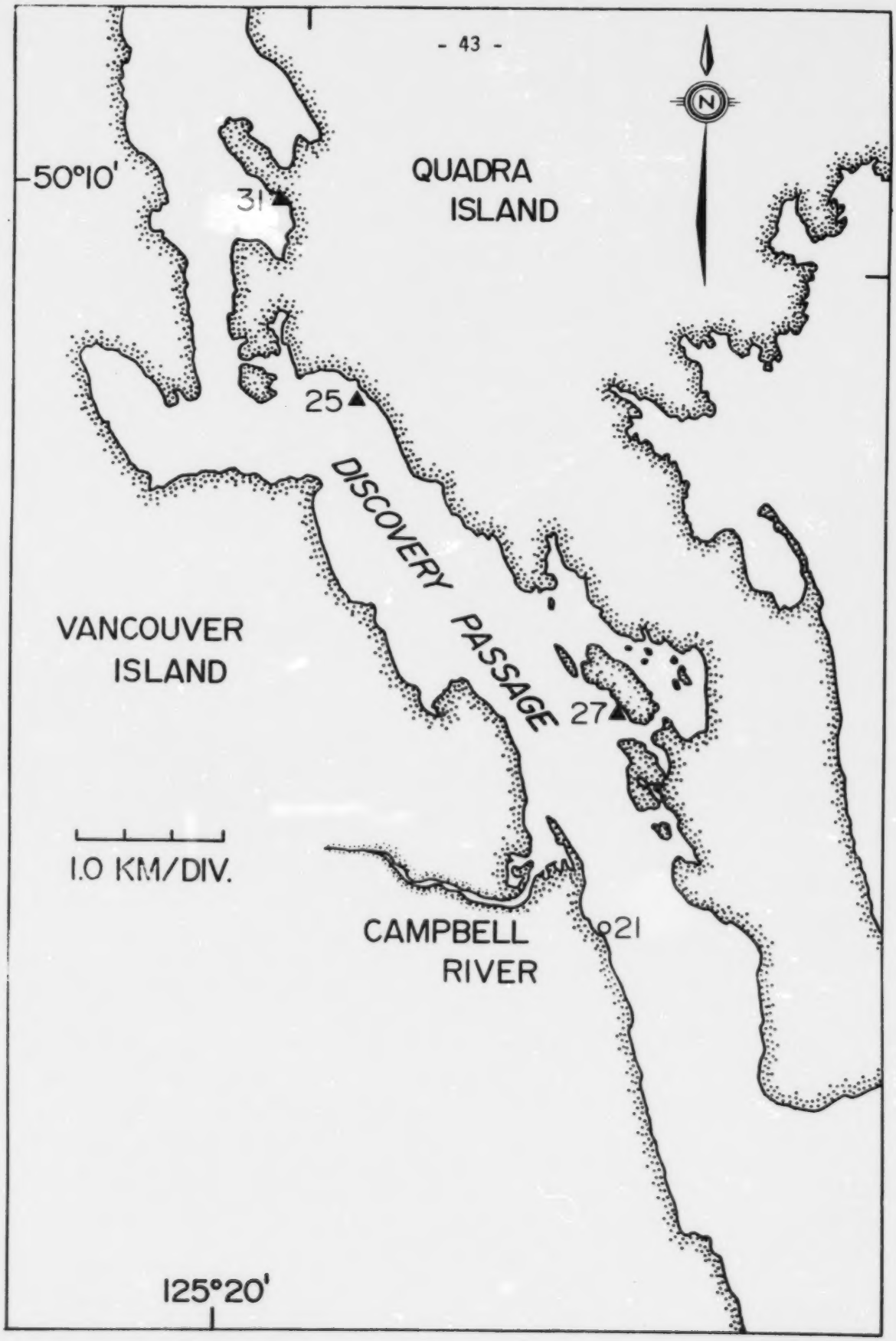
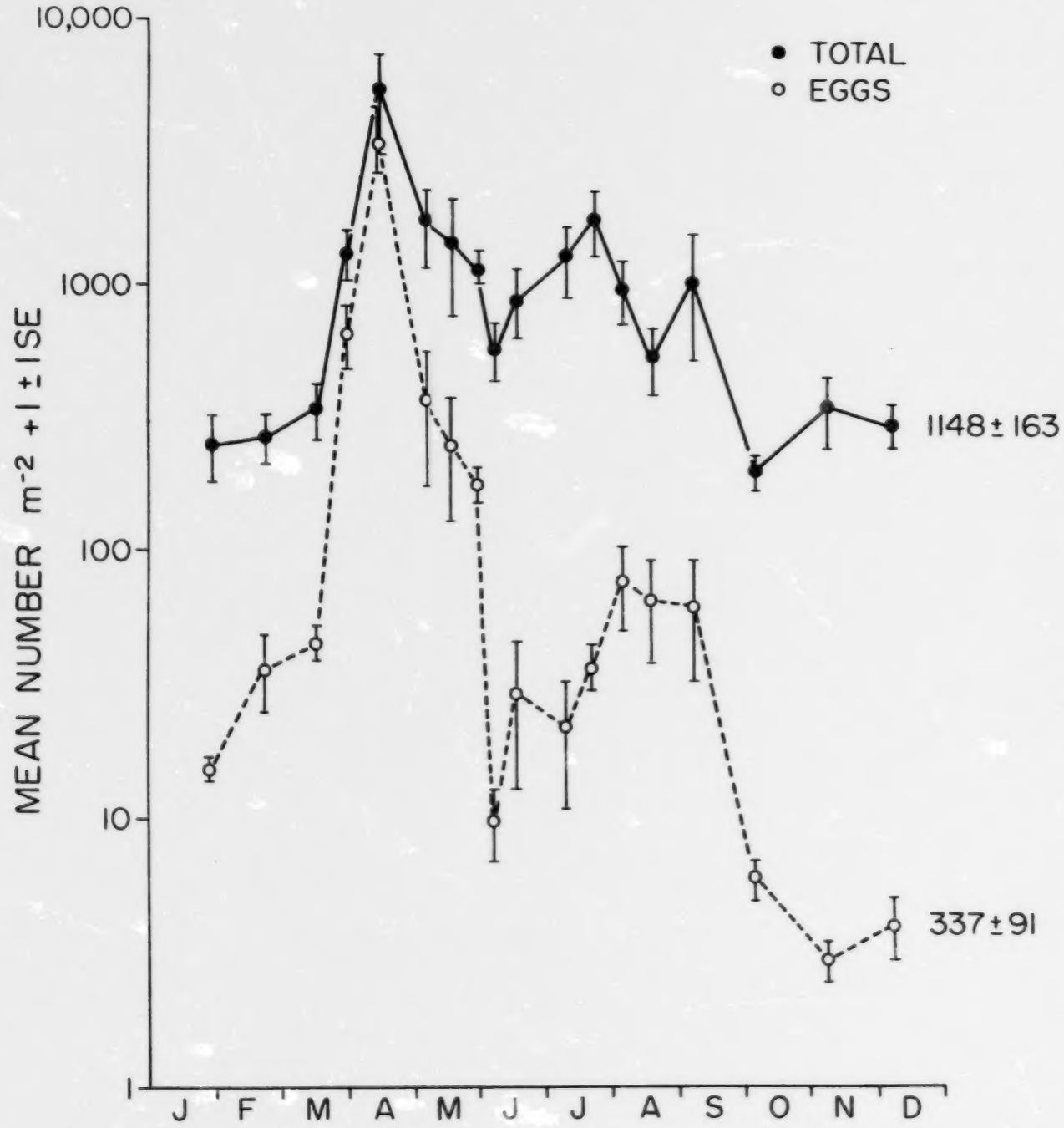

50°10'
31
QUADRA
ISLAND
25
DISCOVERY PASSAGE
VANCOUVER
ISLAND
27
1.0 KM/DIV.
CAMPBELL
RIVER
21
125°20'

Fig. 3. Campbell River estuarine zone 1983. Mean number m^{-2} + 1± 1SE of (a) eggs and (b) harpacticoids for all stations sampled on each date, as compared to total epibenthos.


10,000
1000
100
10
1
MEAN NUMBER m-2 +1 ±1SE
TOTAL
EGGS
1148±163
337±91
J
F
M
A
M
J
J
A
S
O
N
D

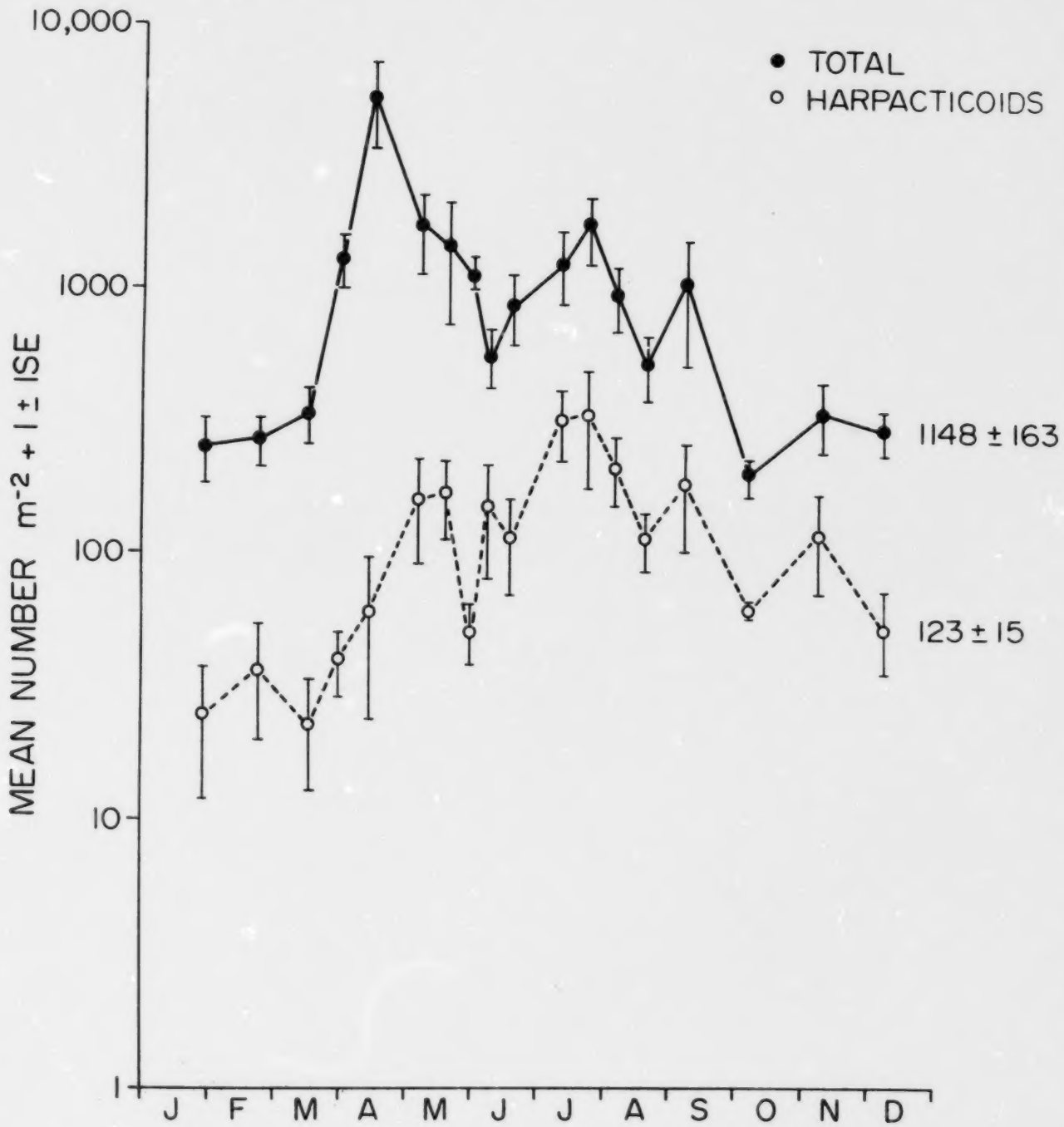
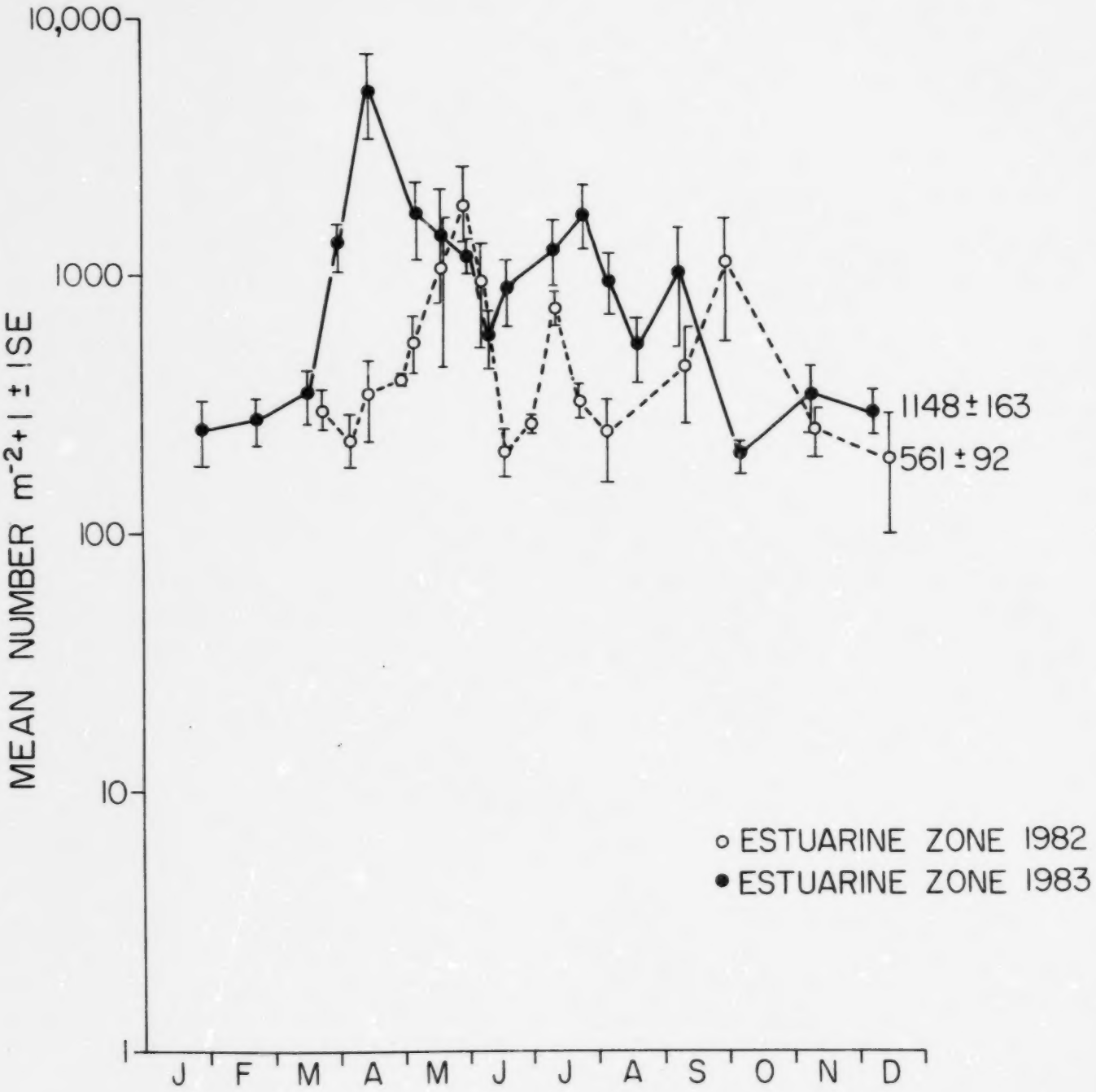

10,000
1000
100
10
1
MEAN NUMBER m⁻² + 1 ± ISE
TOTAL
HARPACTICOIDS
1148 ± 163
123 ± 15
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 4. Campbell River estuarine zone 1982-83. a) mean number $m^{-2}+1\pm1SE$ of total epibenthos for all stations sampled on each date 1982 and 1983. b) mean number $m^{-2}+1\pm1SE$ of total epibenthos for station island three (17) for each date sampled 1982 and 1983.


10,000
1000
100
10
1
MEAN NUMBER $m^{-2}+1 \pm 1SE$
J F M A M J J A S O N D
1148 ± 163
561 ± 92
o ESTUARINE ZONE 1982
• ESTUARINE ZONE 1983

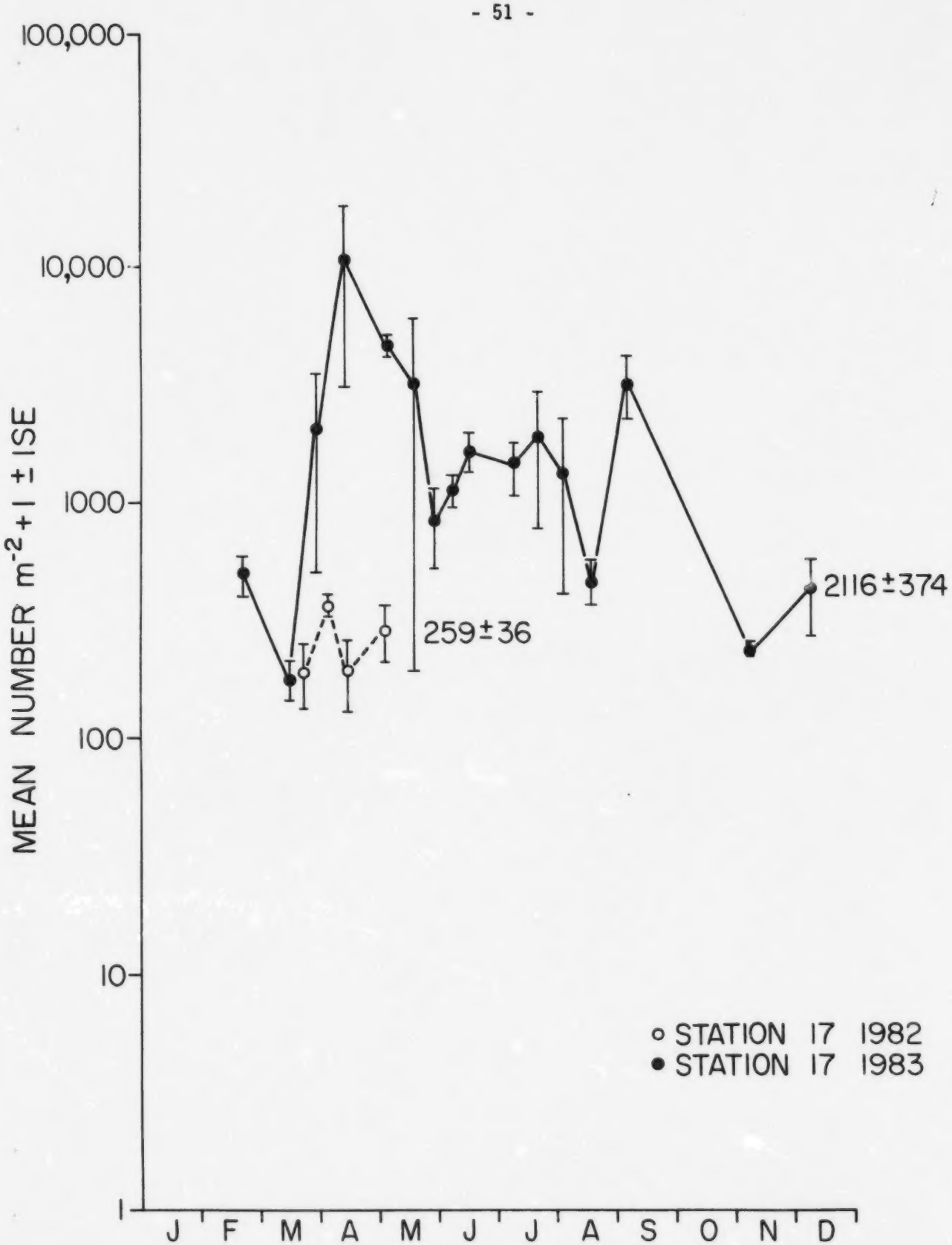
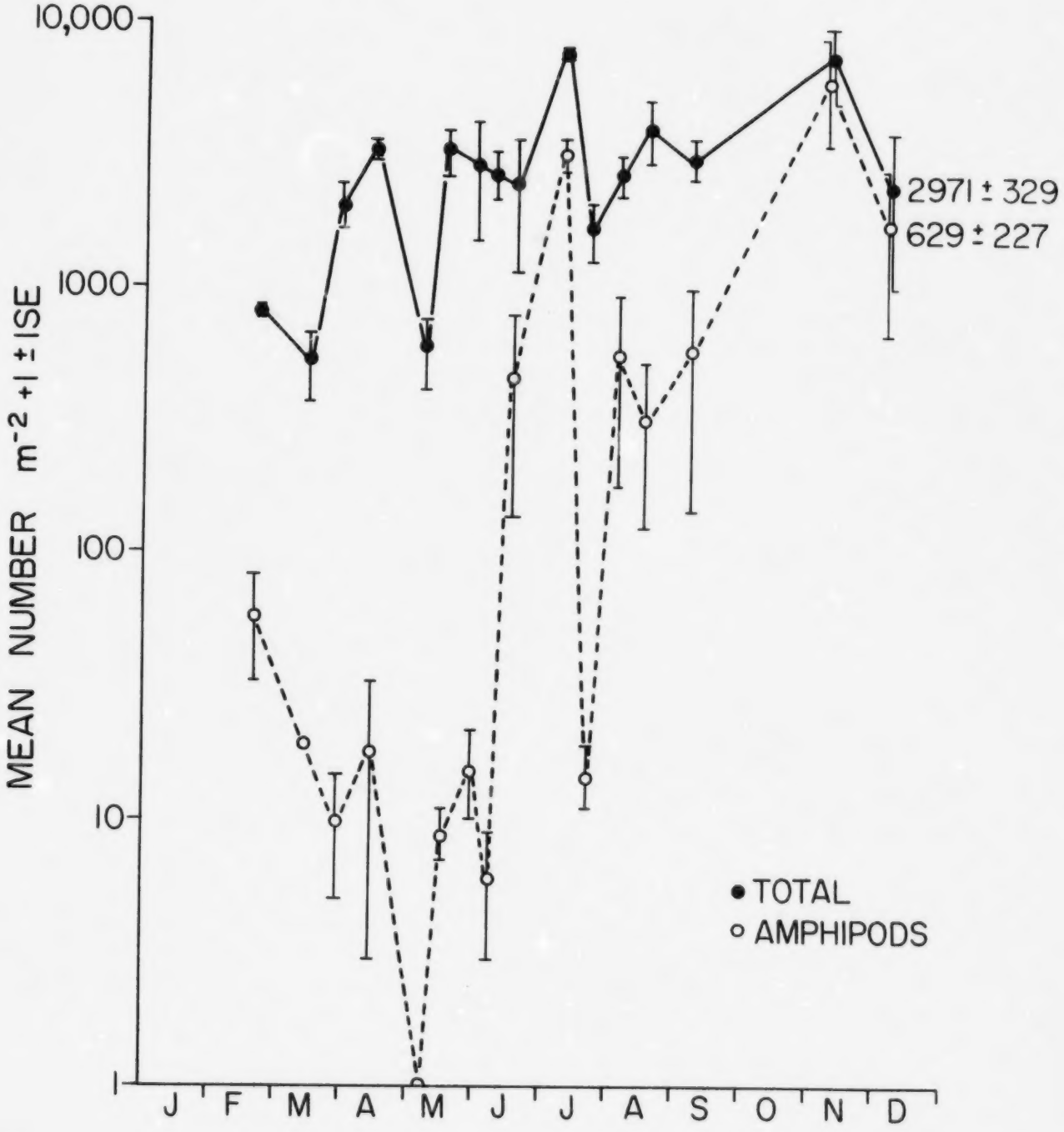

100,000
10,000
1000
100
10
1
MEAN NUMBER m^{-2} + 1 ± ISE
J F M A M J J A S O N D
2116±374
259±36
STATION 17 1982
STATION 17 1983

Fig. 5. Campbell River transition zone 1983. Mean number $m^{-2}+1\pm1$SE of (a) amphipods and (b) harpacticoids for all stations sampled on each date, as compared to total epibenthos.


10,000
1000
100
10
1
MEAN NUMBER m⁻² +1 ± ISE
J F M A M J J A S O N D
2971 ± 329
629 ± 227
● TOTAL
○ AMPHIPODS

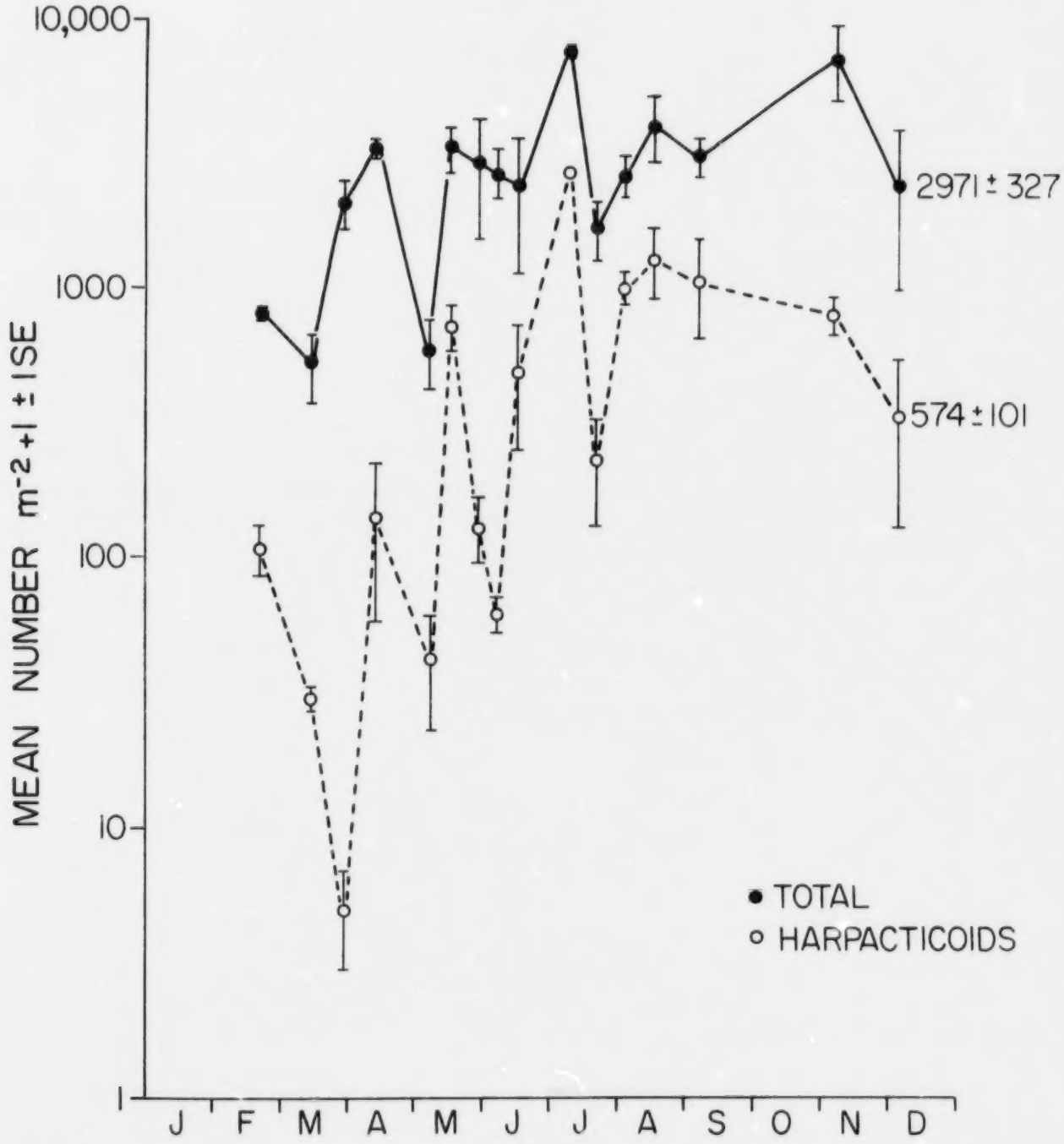

10,000
1000
100
10
1
MEAN NUMBER m⁻² +1 ± 1SE
2971 ± 327
574 ± 101
• TOTAL
○ HARPACTICOIDS
J F M A M J J A S O N D

Fig. 6. Campbell River transition zone 1983. Mean number $m^{-2}+1\pm1SE$ of total epibenthos for stations Boat Ramp (20) and Painters Channel (34) for each date sampled.

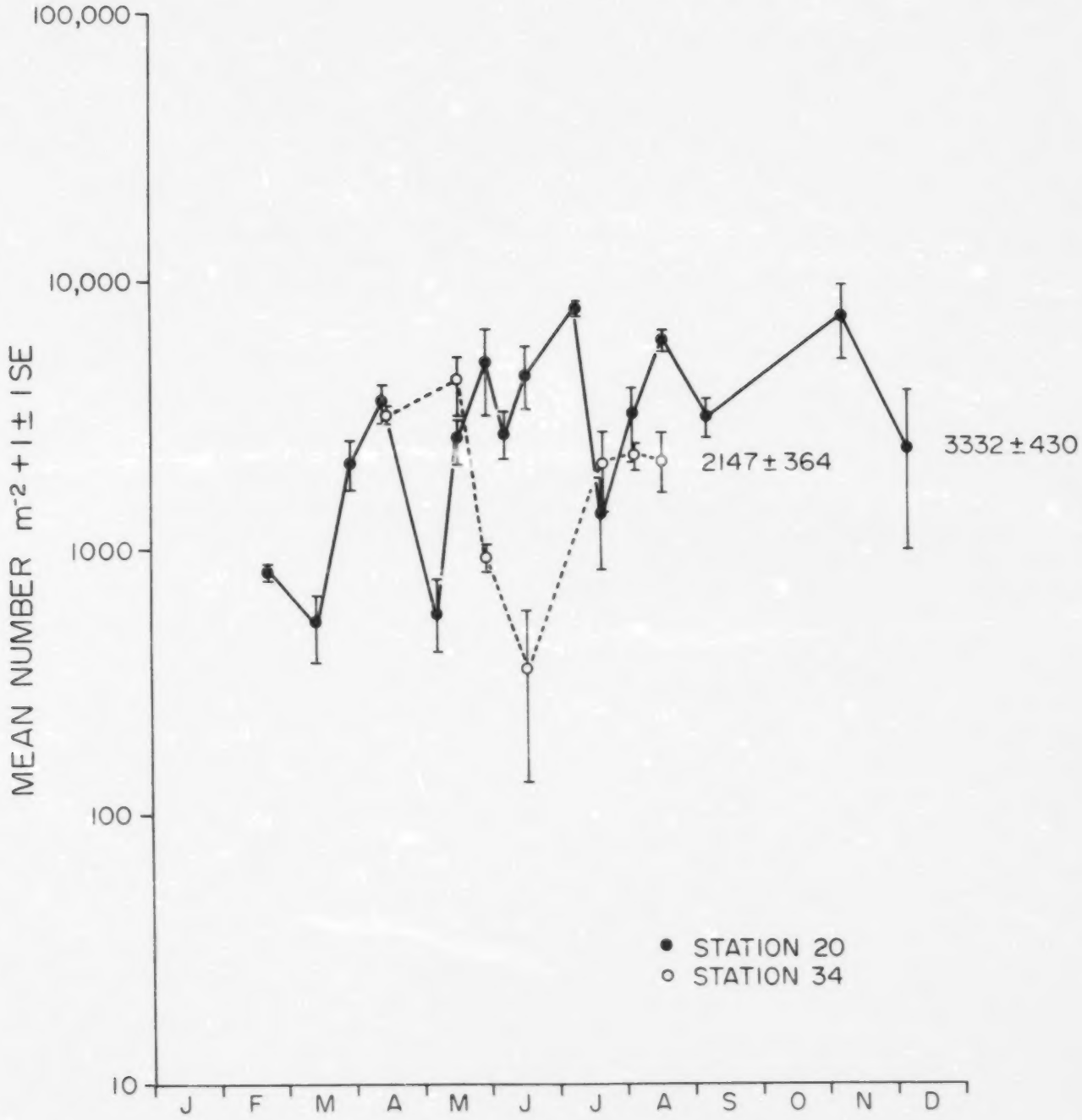
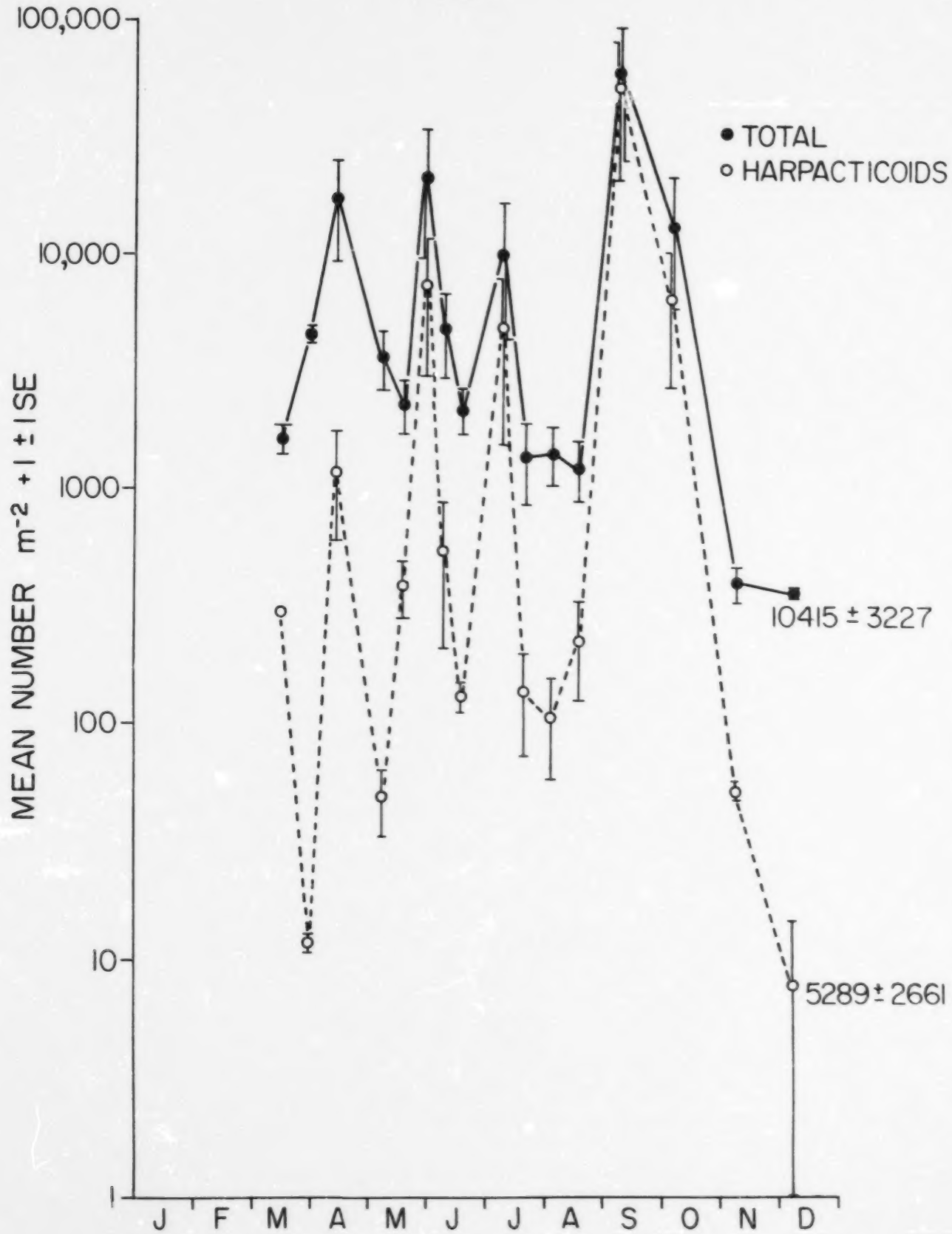

100,000
10,000
1000
100
10
MEAN NUMBER m⁻² + 1 ± 1 SE
J
F
M
A
M
J
J
A
S
O
N
D
2147 ± 364
3332 ± 430
STATION 20
STATION 34

Fig. 7. Campbell River marine zone 1983. Mean number $m^{-2}+1\pm1SE$ of a) harpacticoids and b) amphipods for all stations sampled on each date, as compared to total epibenthos.


100,000
10,000
1000
100
10
1
MEAN NUMBER m-2 +1 ±1SE
J F M A M J J A S O N D
• TOTAL
o HARPACTICOIDS
10415 ± 3227
5289 ± 2661

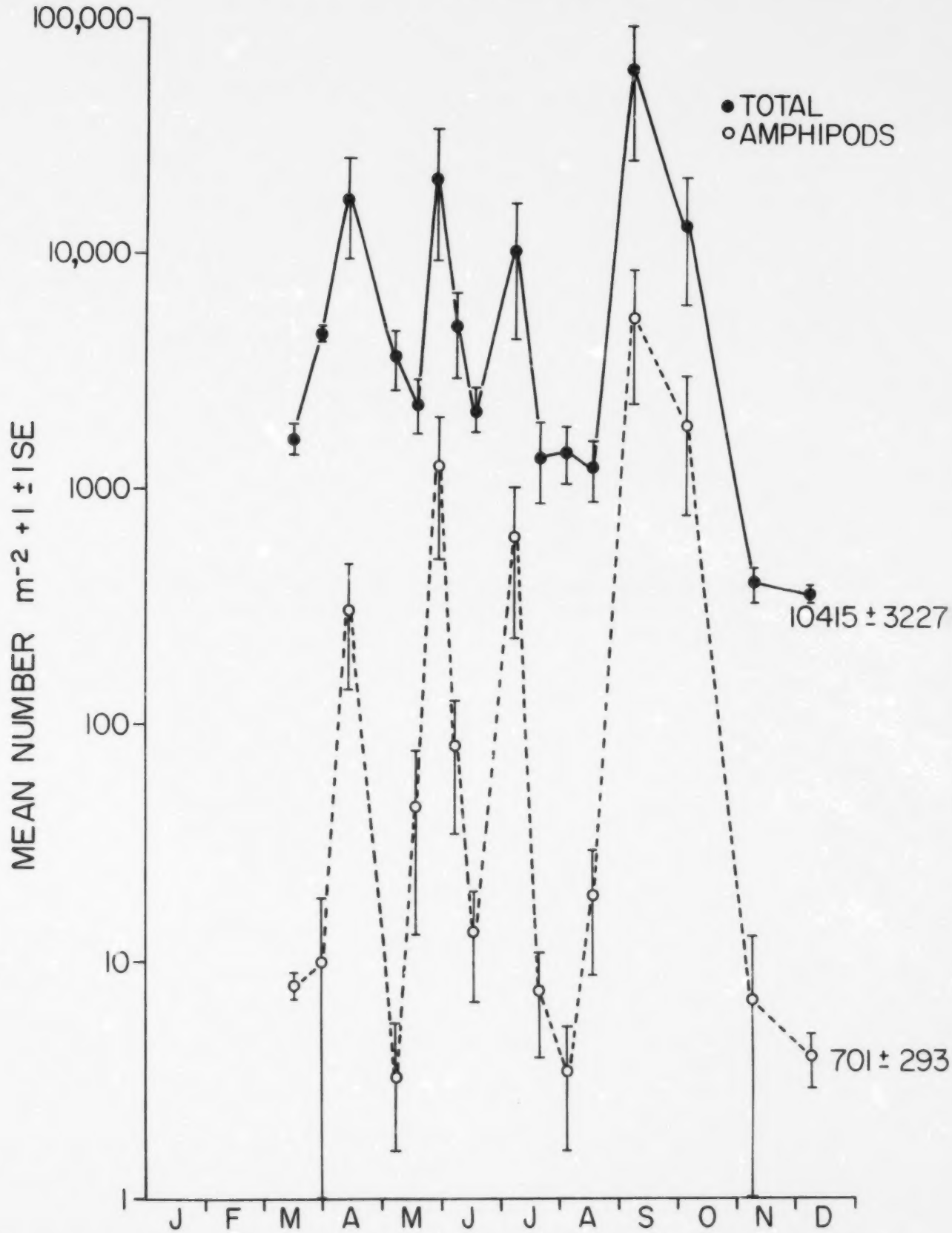

100,000
10,000
1000
100
10
1
MEAN NUMBER m-2 +1 ±1SE
TOTAL
AMPHIPODS
10415 ± 3227
701 ± 293
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 8. Campbell River marine zone 1983. Mean number $m^{-2}+1\pm1SE$ of total epibenthos for stations Outer Gowlland (27) and Plumper Bay (31) for each date sampled.

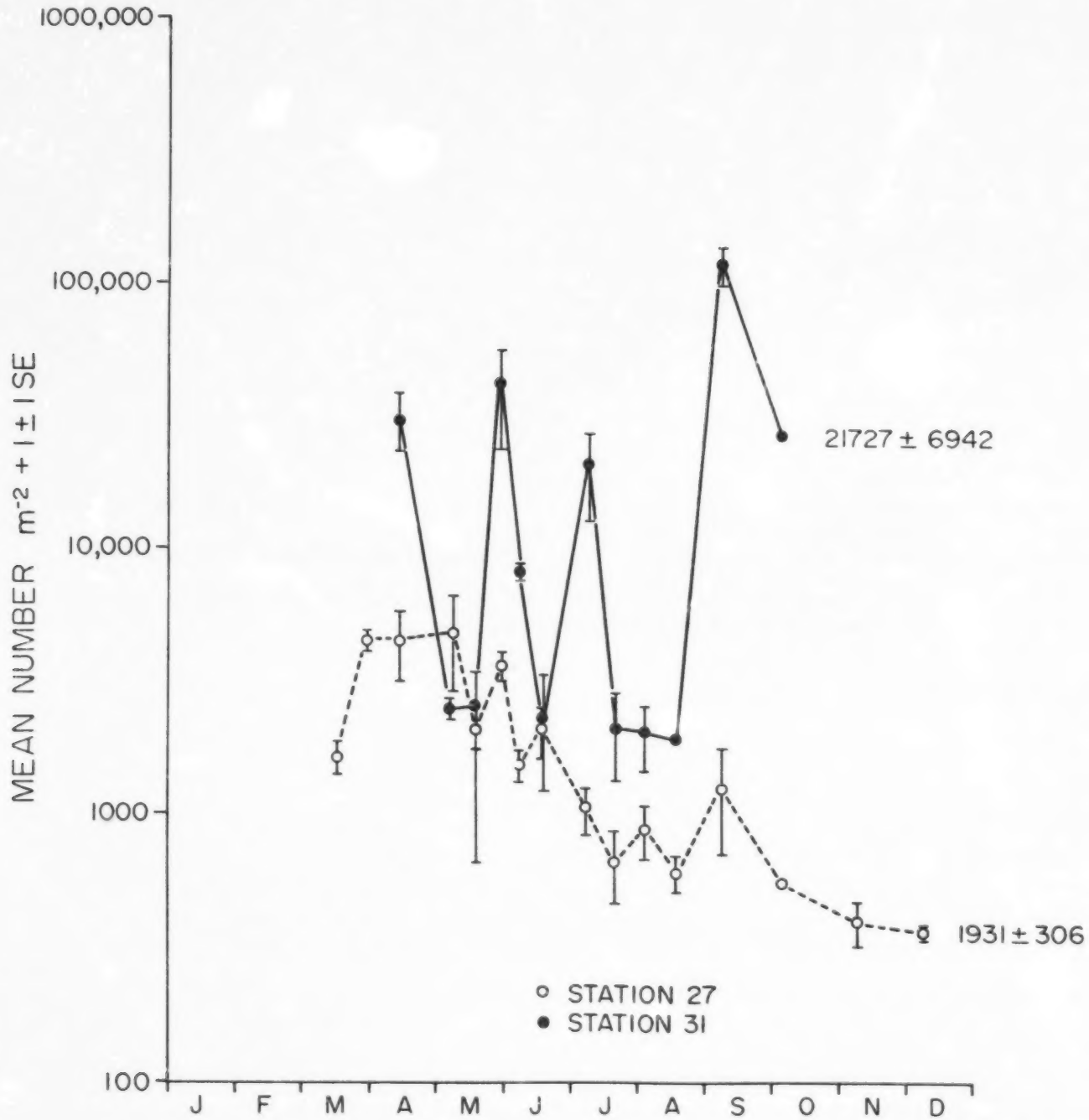
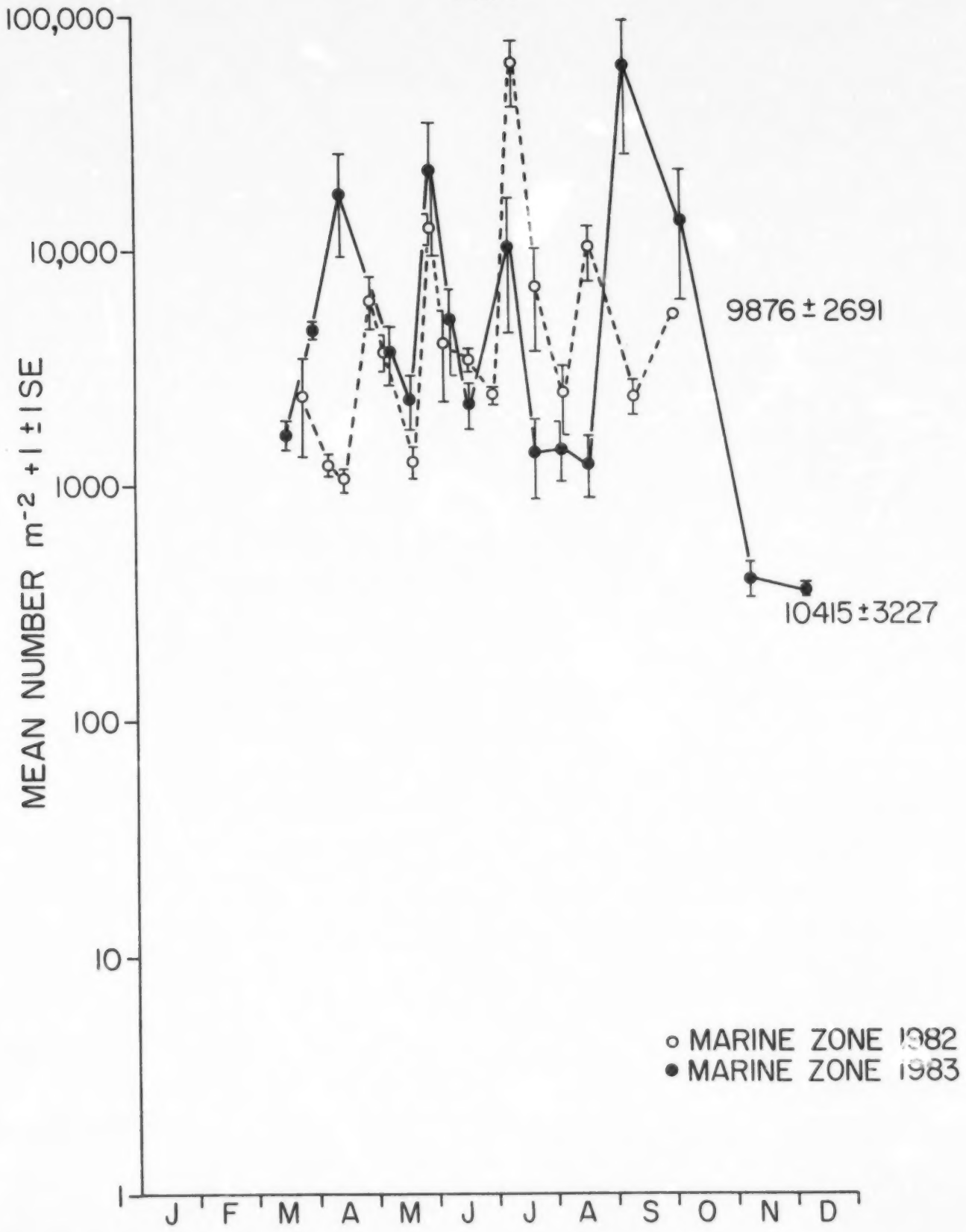
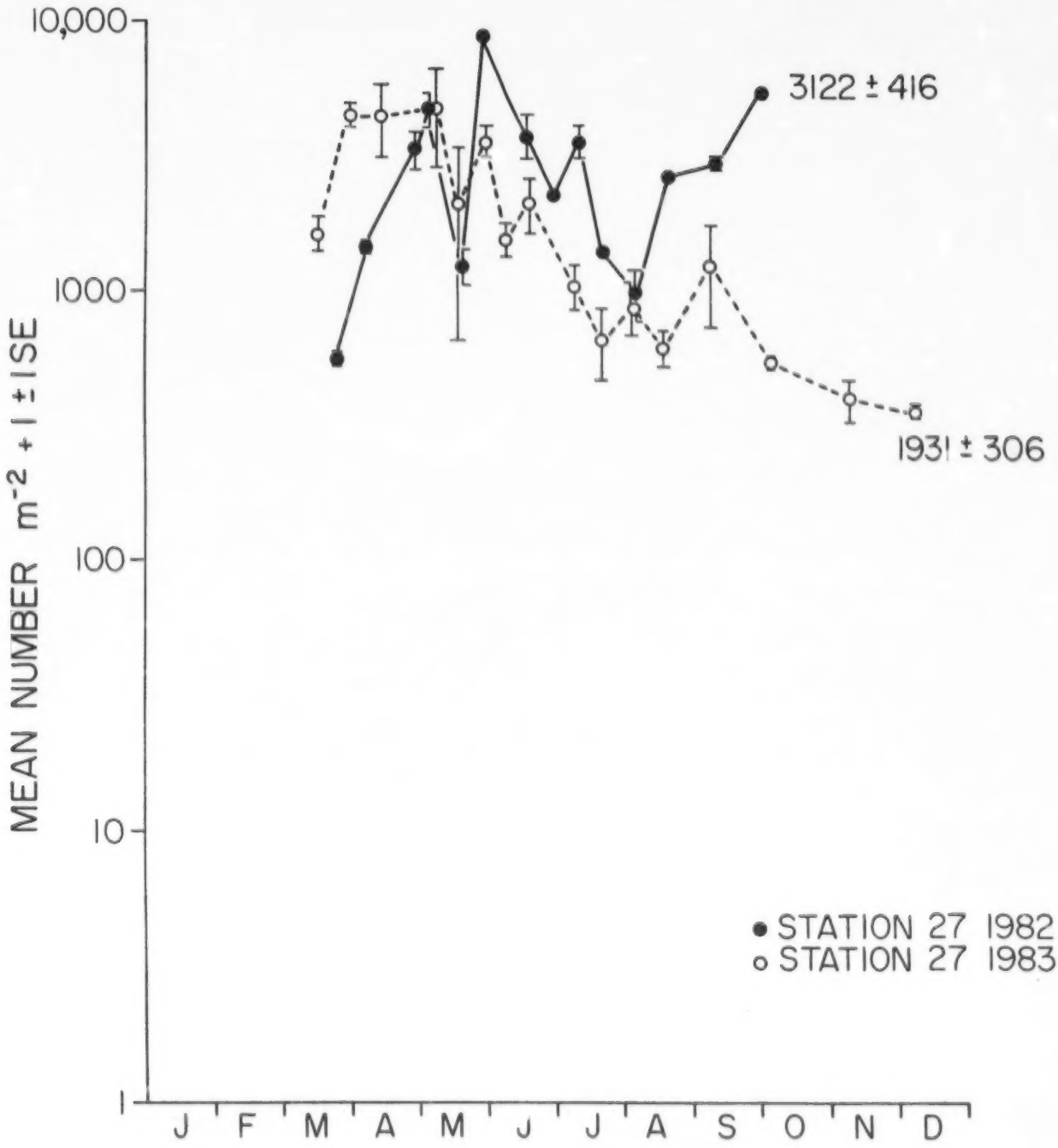

1000,000
100,000
10,000
1000
100
MEAN NUMBER m⁻² + 1 ± 1 SE
21727 ± 6942
1931 ± 306
STATION 27
STATION 31
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 9. Campbell River marine zone 1982-83.
a) Mean number $m^{-2}+1\pm1SE$ of total epibenthos for all stations sampled on each date 1982 and 1983.
b) Mean number $m^{-2}+1\pm1SE$ of total epibenthos for station Outer Gowlland (27) for each date sampled 1982 and 1983.
c) Mean number $m^{-2}+1\pm1SE$ of total epibenthos for station Plumper Bay (31) for each date sampled 1982 and 1983.


100,000
10,000
1000
100
10
1
MEAN NUMBER m-2 +1 ±1 SE
9876 ± 2691
10415 ± 3227
o MARINE ZONE 1982
• MARINE ZONE 1983
J F M A M J J A S O N D


10,000
1000
100
10
1
MEAN NUMBER m⁻² + 1 ± 1SE
3122 ± 416
1931 ± 306
• STATION 27 1982
o STATION 27 1983
J F M A M J J A S O N D

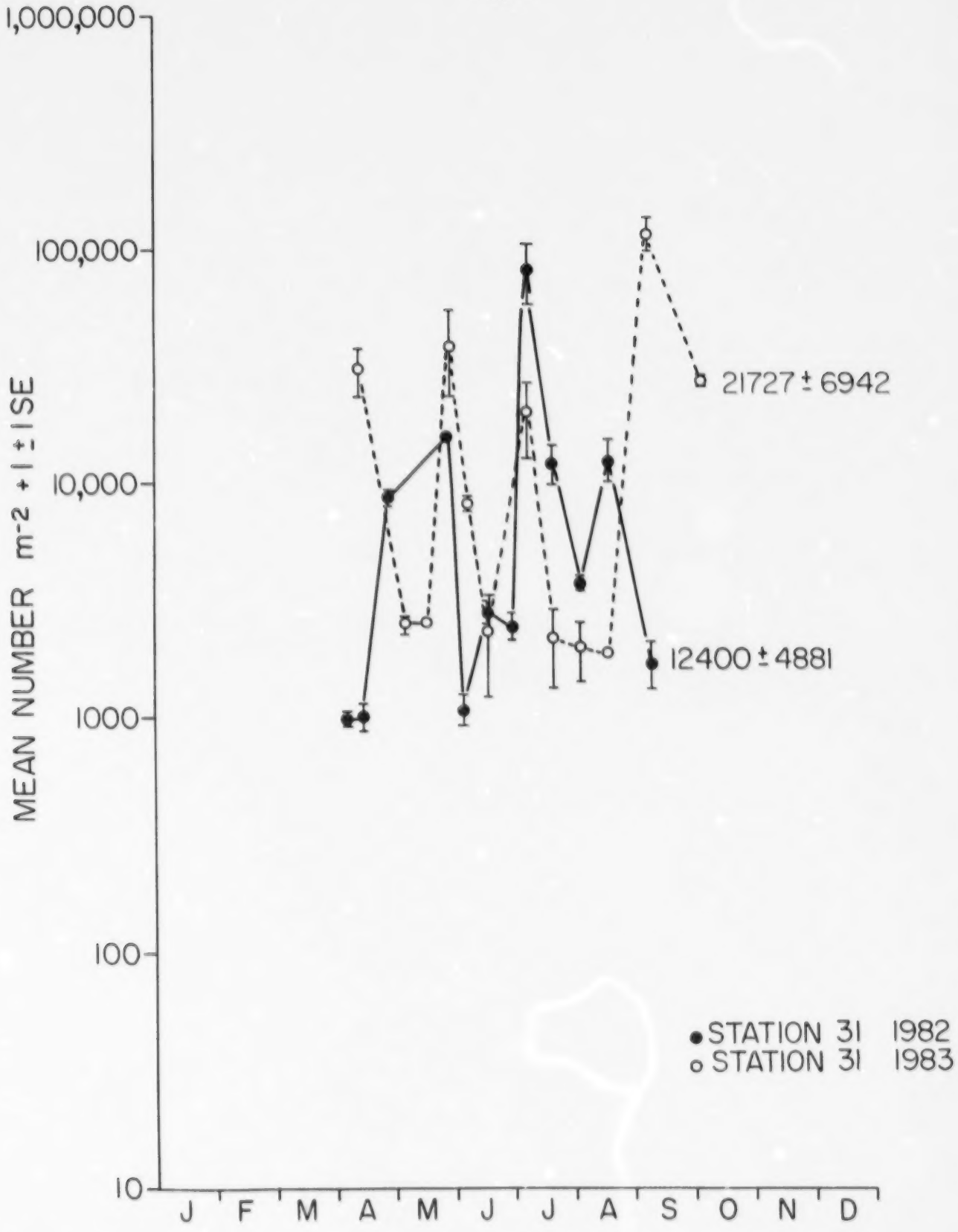
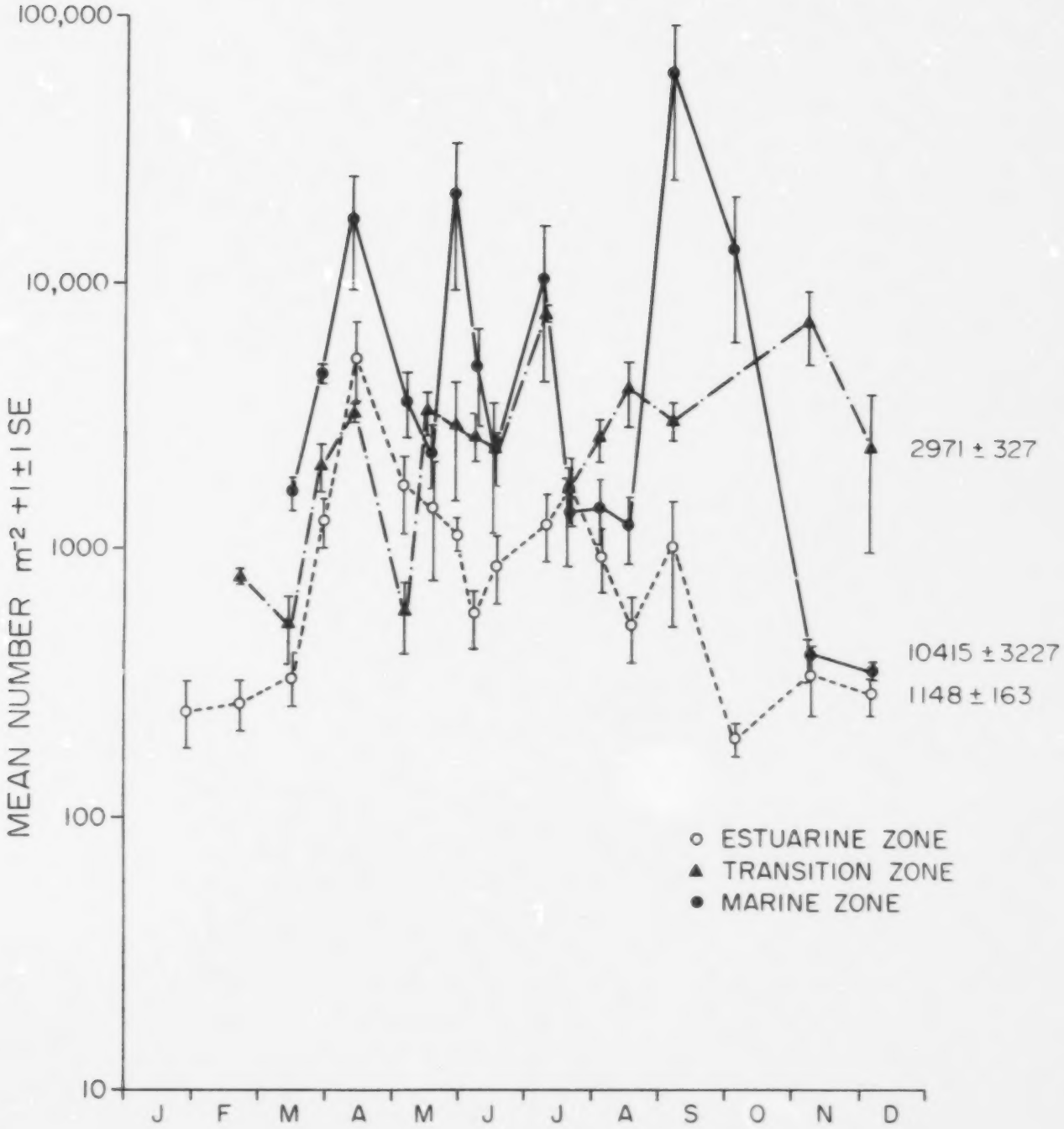

1,000,000
100,000
10,000
1000
100
10
MEAN NUMBER m-2 + 1 ± 1 SE
21727 ± 6942
12400 ± 4881
• STATION 31 1982
o STATION 31 1983
J F M A M J J A S O N D

Fig. 10. Campbell River 1983 zonal comparison. Mean number $m^{-2}+1\pm1SE$ of total epibenthos for all stations sampled on each date in the estuarine, transition and marine zones.


100,000
10,000
1000
100
10
MEAN NUMBER m⁻² +1 ±1 SE
J
F
M
A
M
J
J
A
S
O
N
D
2971 ± 327
10415 ± 3227
1148 ± 163
ESTUARINE ZONE
TRANSITION ZONE
MARINE ZONE